



UNIVERSITAT
POLITÈCNICA
DE VALÈNCIA



> 8th SYMPOSIUM OF THE EUROPEAN ASSOCIATION OF ACAROLOGISTS

Universitat Politècnica de València

July, 11th -15th 2016



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WELCOME

Dear colleagues,

I am very pleased to welcome you at the 8th Symposium of the European Association of Acarologists (EURAAC) at the Universitat Politècnica de València, Valencia, Spain.

Around 180 participants from 31 countries belonging to four continents have joined this event and I would like to thank all of you for your confidence and interest in attending the symposium.

Together with the organizing committee we have tried to offer an attractive scientific and social programme in a multidisciplinary meeting environment. The scientific and social activities will take place during five days and will include plenary conferences, special sessions on specific topics, an open round table, and oral presentations and posters divided into the nine proposed topics. The social events include a Welcome reception and a Gala dinner in attractive scenarios, moreover activities in the city for accompanying persons to show the major attractions and the ancient history of Valencia.

Our meeting will be an excellent forum to establish new links and collaborations among participants. In addition, we are very fortunate to have three internationally recognised speakers who will present the latest advances in Acarology in a wide range of interesting topics.

A round table open for all participants will give the possibility to raise a discussion about the use and abuse of acarological information in scientific journals and media.

Finally, I would like to thank everybody, individuals as well as organizations, who has provided excellent advises and support to our team. I also want to thank all members of our organizing committee and the staff of the Technical office at the Universitat Politècnica de Valencia for their hard work and dedication to the event.

We hope to meet all of your expectations and I wish you a pleasant stay enjoying the attractiveness of Valencia.

Francisco Ferragut

President of the European Association of Acarologists (2012-2016)

Chairman of the Organizing Committee of the 8th Symposium of EURAAC

COMMITTEES

EURAAC President and Chairman of the Symposium

Francisco Ferragut Pérez
Instituto Agroforestal Mediterráneo
Universitat Politècnica de València

LOCAL ORGANIZING COMMITTEE

Rafael Laborda Cenjor
Departamento de Ecosistemas Agroforestales. Universitat Politècnica de València

Cynthia Rivera Seclén
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Josep Anton Jaques i Miret
Departament de Ciències Agràries i del Medi Natural. Universitat Jaume I. Castelló

Adeilma Nascimento de Carvalho
Universidade Estadual de Santa Cruz, Ilhéus, BA, Brazil

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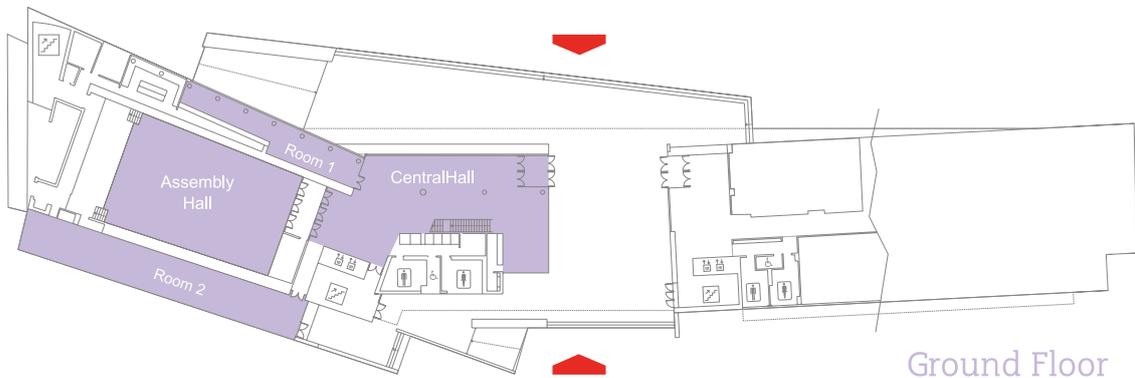


SYMPOSIUM VENUE

Nexus Building, Polytechnic University of Valencia, Spain. 11th – 15th July 2016
<http://euraac.webs.upv.es/>



Nexus Building (6G)



GENERAL INFORMATION

1. Registration

The registration desk is located in the central hall of Nexus Building, ground floor. Registration is open on Monday through Thursday from 08:00 to 12:40 h.

2. Presenter Guidelines

Oral Presentations

Oral presentations should be prepared with MS PowerPoint (.ppt or .pptx). The time allocated to each presentation will be 20 min in total, with a maximum of 15 minutes for the talk and a maximum of 5 minutes for questions and discussions.

All speakers including both general sessions and special sessions should leave your presentation file the day before the presentation in case of morning sessions (except for morning session on Monday 11th) or in the same morning in case of afternoon sessions.

Poster session

The poster session will take place in the Exhibition Rooms (Room 1 and 2), Nexus Building, on Tuesday (July 12th) from 17:00 to 18:30 and on Thursday (July 14th) from 17:30 to 19:00. The two exhibition rooms are located adjacent to the Assembly Hall.

All the posters will be displayed at the same time and will be available from Tuesday to Thursday. Authors have to set up their posters on Monday 11th from 16:00 to 17:00 h or on Tuesday 12th from 14:00 to 15:40. Each poster has a unique reference number, which will be indicated on the poster boards and the Abstract book.

Poster presenters should attend the two poster sessions and they will receive a certificate of your attendance. All posters should be removed on Thursday at 19:00.

3. Student Awards

All student presentations given at the EURAAC Symposium will compete for the best oral presentation and best poster awards. The best oral and poster presentations will be selected during the Symposium by the scientific committees of the EURAAC and handed out during the closing session.

- 500€ for the most outstanding poster, financed by Koppert Biological Systems B.V.
- 500€ for the most outstanding oral presentation, financed by the European Association of Acarologists.

4. Proceedings

All the accepted papers will be published in a special issue by the journal *Acarologia*, and accessible through the journal's website as a pdf document (not in paper form).

Manuscripts should be prepared following the instructions of the journal *Acarologia* (<http://www1.montpellier.inra.fr/CBGP/acarologia/instructions.php>) and will be accepted until July 15th.

It is expected to publish the accepted manuscripts at the end of 2016 or in early 2017.



5. Venue Locations

Registration	Central Hall. Nexus building
Oral Presentation	Assembly Hall - Classroom 2.7. Nexus building
Poster Presentation	Exhibition rooms 1 - 2. Nexus building, ground floor
Coffee Break	Central Hall. Nexus building
Lunch	Restaurante Galileo Galilei, next to the Nexus Building
Welcome Reception	Contrapunto Les Arts Restaurant Palau de les Arts Reina Sofia. Ciudad de las Artes y las Ciencias www.restaurantecontrapuntolesarts.com (without shuttle bus services)
Gala Dinner	Huerto de Santa María Restaurant Camino Puig de Cebolla, 4. 46540 El Puig, Valencia www.huertodesantamaria.com (shuttle buses will pick you up at the hotels)

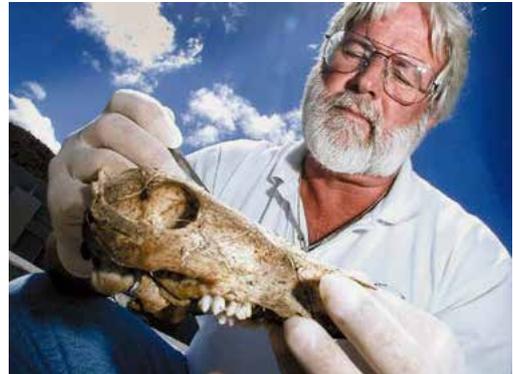
PLENARY LECTURES

Dr. Lee Goff. Professor Emeritus in Entomology and Forensic Sciences at Chaminade University of Hawaii.

Acarine C.S.I.: The Show, The legal System and The Mites

The television series “CSI Las Vegas” premiered in October 2000 and was an unexpected hit series, running for 15 complete seasons with a shortened 16th season. Unlike most crime series in the United States, it was set primarily in a crime laboratory in Las Vegas, featured a forensic entomologist/acarologist as a lead character and focused on forensic examinations of evidence rather than frantic police pursuits and gunfire. Basically, most executives were not planning much past the pilot. Instead the series continued and spawned 3 additional shows:

“CSI New York, CSI Miami and CSI Cyber.” For the first 2 seasons, many of the plots were based on actual cases from Hawaii as detailed in the book “A Fly for the Prosecution.” Suddenly the general population was exposed to the forensic sciences and became interested to the extent that juries began to anticipate that forensic evidence and tests would be present in all cases, much to the dismay of the legal community on both sides. This resulted in what became known as the “CSI Effect” and has not been limited to the United States. In this presentation, the process of adapting cases originally from Hawaii to the deserts surrounding Las Vegas will be discussed, comparing actual case materials and resolutions with final TV plots. Cases to be presented involved insects and an assortment of mites ranging from soil dwelling taxa, to ticks and chiggers. The implications of the “CSI Effect” to the United States legal system will be presented along with examples of problems and concerns.



Dr. Ronald Ochoa. Research Entomologist (Acarologist) at USDA, ARS, BA, PSI Systematic Entomology Laboratory, Beltsville, USA.

Low Temperature SEM: An Acari window

Ronald Ochoa¹, Jennifer J. Beard², C. Welbourn³, John Hammond⁴, Gabriel Otero-Colina⁵, Chris Pooley⁶ and Gary R. Baughan⁶

1.USDA, ARS, Systematic Entomology Lab, BARC-West, 10300 Baltimore Ave, Beltsville, MD, 20705, USA. 2.Queensland Museum, PO Box 3300, South Brisbane, Queensland, 4101, Australia. 3.Division of Plant Industry, Florida Dept. Agriculture & Consumer Services, Gainesville, FL, 32614, USA. 4. USDA, ARS, NA, Florist and Nursery Plants Research Unit, 10300 Baltimore Ave, Beltsville, MD, 20705, USA.

5.Colegio de Postgraduado, Montecillo, Km 36.5 Carretera Mexico-Texcoco. Montecillo, Texcoco, 56230, Mexico. 6. USDA, ARS, Electron & Confocal Microscopy Unit, 10300 Baltimore Ave, Beltsville, MD, 20705, USA



Nearly 60,000 mite species have been described thus far but the entire life cycles of only a few have been studied. Some mites live deep in soil, others in fresh or sea water, some are found on plants, algae, fungi or animals, and still others are able to survive in both extreme low and high temperatures. Their feeding habits are just as varied, including species that are parasitic, predatory, mycophagous, sapro-fagous, and phytophagous. Some are sclerotized, some have plates, and some are soft bodied. Some mites are associated with viruses and fungi and cause diseases of animals and plants. Plant-feeding mites are known to infest nearly all species of plants, including economically significant crops, timber, and ornamental plants, and cause losses to national and/or international food and fiber markets. Many animals (including insects) have mites that are phoretic, parasitic or associated with their nesting. All species of domesticated animals, and all humans, are hosts of parasitic mites.

Electron microscopy is a tool to observe external and internal structures of plants, animals and materials at resolutions and magnifications that far exceed light microscopy. In addition, structures can be photographed with greater depth of field and in stereo, revealing their true three-dimensional structures. Many research projects need microscopic obser-



vations in order to understand a certain facet of a structure and how it relates to function, but the costly and highly specialized equipment required for such observation often makes these data difficult to obtain. The observation of minute specimens, such as mites, often requires the development of new procedures for specific sample preparation. Furthermore, it is usually necessary to prepare digital images of specimens for purposes of publication, and these often require the use of complex imaging and colorization technologies and techniques that are not available to most research units. Studying the structure and the interaction of pathogens/pests, with their hosts using low temperature scanning electron microscopy (LT-SEM) provides valuable information key to understanding mite behavior and for developing management or control strategies for these pests. Detailed images of plant and animal tissue, stored grain products and animal nest material help identify the location where mites congregated in their natural habitat. The ability to identify and understand animal and plant mite pest associations is critical to making decisions aimed at preventing the introduction and/or controlling the spread of newly introduced mites. Instantaneous immobilization of mites and insects using super-cooled brass bars submerged in liquid nitrogen (-196°C) allows specimens to be studied in-situ on host materials in their natural state. Thus, such intimate observation of the interactions between insect pests, mites, animal and human parasites, fungi, bacteria and virus particles, and their hosts, provides a unique insight into the biology of these interactions.

This presentation addresses the use of LT-SEM to better understand the variation in external structures in animal and plant mites, and to collect biological and ecological data. New morphological characters have been discovered using LT-SEM that have enabled us to better characterize important economic species, distinguish cryptic species, and correlate taxonomic and molecular data on these species. This technique is helping researchers discover and understand morphological variation from a mite's point-of-view, and has ultimately provided us with a view into their microscopic world.

Dr. Marie-Stéphane Tixier. Professor in Montpellier SupAgro (Agriculture University), Montpellier, France, and Researcher at the UMR CBGP.

Mite Systematics: research and education challenges for the future

Systematics is the basal Science that secures all the other biological Sciences and applications in Agriculture, Health and Environment. New approaches and methods combined with traditional ones have led to important advances in phylogeny and evolution, biodiversity discovery, diagnostic implementation, big data management and in associated applied fields as biological control, biodiversity management, risk previsions under global changes. The presentation will draw a state of

such advances, dress some future research challenges and will question the future of Acari Systematics considering education of students, systematics attractiveness, student grants and perennial positions in our European institutions.



SPECIAL SESSIONS

Climate change and bioinvasions as interconnected challenges

Hosted by Maria Navajas. INRA, UMR, Centre de Biologie pour la Gestion des Populations, Montferrier-sur-Lez, France
Denise Navia. Embrapa Recursos Genéticos e Biotecnologia, Brasília, DF, Brazil
Menelaos Stavrinides. Department of Agricultural Sciences, Biotechnology and Food Science, Cyprus University of Technology, Limassol, Cyprus

Forensic Acarology

Hosted by María Alejandra Perotti. School of Biological Sciences, University of Reading, Reading, UK

ROUND TABLE

The Round Table **Ignorance of acarology undermines research validity will be chaired** by Dr. Alejandra Perotti, University of Reading, UK

The number of acarologists is steadily declining at least in Western Europe, and, unfortunately, we have to live with the fact that this will not change in the foreseeable future. The amount of research in acarology hasn't decreased and is increasingly done by people lacking sufficient training and expertise in the field of acarology. Manuscripts on research on fundamental mechanisms in ecology or applied aspects in medical entomology or forensic biology using mites will likely not face any acarologist any more during peer review. Publications where either the mite species is no longer identified, wrongly identified, or where flawed assumptions are made about the biology of a species, become scientific invalid. A publication with unidentified mite species represents in fact research that is not reproducible, and this strikes at the heart of the scientific method. A publication where mite species are wrongly identified; for example, authors assume it is a common species that had been named in other publications, or identifying mites by comparing pictures on the web instead of with an appropriate key; these publications are just wrong and do not belong in the literature cannon. The problem is not limited to identification. For example, ecologists might assume life history traits common for arthropods that are actually different in crucial points for the particular mite species they are working with and therefore derive invalid conclusions, which might lead to constructing invalid models. This can have a snowball effect by misleading other researchers who base their premises and build their hypotheses on published work that is invalid. These researches might waste lots of time and funding pursuing dead ends and/or even jeopardize their careers.

The purpose of this discussion is to get together to find a strategy to, for example, make better use of the still existing (or living) body of expertise in acarology. The roundtable will start with a presentation of several, concrete case studies illustrating the problem. The audience is then invited to express their opinion regarding the problem and the desirability of a particular solution. We would like to invite EURAAC members to discuss options; senior acarologists and editors of acarological journals are especially solicited for their view.





SCIENTIFIC AND SOCIAL ACTIVITIES AT A GLANCE

Assembly Hall, Nexus Building (Salón de Actos, Edificio Nexus)					
	Monday 11 th	Tuesday 12 th	Wednesday 13 th	Thursday 14 th	Friday 15 th
8 - 12:40	Registration	Registration	Registration	Registration	
9 - 10:40	Opening Ceremony	Guest speaker Marie-Stéphane Tixier	Guest speaker Ronald Ochoar	Guest speaker Lee Goff	Behavioural Ecology and Life History Strategies
	Plenary Conference				
	Biological Control and IPM	Taxonomy, Systematics and Phylogeny	Climate change and bioinvasions as interconnected challenges*	Forensic Acarology*	
10:40 - 11:00	Coffee Break	Coffee Break	Coffee Break	Coffee Break	
11 - 12:40	Biological Control and IPM	Taxonomy, Systematics and Phylogeny	Climate change and bioinvasions as interconnected challenges*	Forensic Acarology*	Coffee Break
			Cultural Acarology		EURAAC Meeting
12:40 - 14:00	Lunch	Lunch	Lunch	Lunch	Closing Ceremony
14 - 15:40	Biological Control and IPM	Taxonomy, Systematics and Phylogeny	Field Ecology and Population Dynamics	Genetics and Evolutionary Acarology	
15:40 - 16:00		Coffee Break	Coffee Break	Coffee Break	
16 - 17:20		Taxonomy, Systematics and Phylogeny	Field Ecology and Population Dynamics	Ignorance of Acarology undermines research validity **	
	Welcome Reception 19:30	Poster Session 17 - 18:30	Gala Dinner 20:00	Poster Session 17:20 - 19:00	* Special Sessions ** Round Table

Classroom 2.7, second floor, Nexus Building (Aula 2.7, segunda planta, Edificio Nexus)					
	Monday 11 th	Tuesday 12 th	Wednesday 13 th	Thursday 14 th	Friday 15 th
8 - 12:40	Registration	Registration	Registration	Registration	
9 - 10:40		Chemical Control Resistance and Toxicology		Biogeography and Biodiversity	Medical and Veterinary Acarology
	Morphology and Physiology				
10:40 - 11:00	Coffee Break	Coffee Break	Coffee Break	Coffee Break	
	Morphology and Physiology			Biogeography and Biodiversity	Coffee Break
12:40 - 14:00	Lunch	Lunch	Lunch	Lunch	
14 - 15:40	Morphology and Physiology			Biogeography and Biodiversity	
15:40 - 16:00		Coffee Break	Coffee Break	Coffee Break	
	Welcome Reception 19:30	Poster Session 17:00 - 18:30	Gala Dinner 20:00	Poster Session 17:30 - 19:00	



SCIENTIFIC PROGRAM: ORAL PRESENTATIONS

Monday July 11th – Thursday 14th

08:00 - 12:40 Registration

Central Hall – Nexus building

Monday July 11th, Assembly Hall

09:00 - 10:00 Opening Ceremony. Plenary conference

09:00 - 09:20 Opening Ceremony and Presentation

09:20 - 10:00 Acarology in Spain

María Lourdes MORAZA, Juan Carlos ITURRONDOBEITIA and Ferran GARCÍA MARÍ

10:00 - 10:40 Biological Control and IPM (concurrent sessions)

Moderators: Eric Palevsky and Maria L. Pappas

10:00 - 10:20 Markus KNAPP, Yvonne M. VAN HOUTEN, Elmer VAN BAAL, Hans HOOGER BRUGGE, Tom GROOT

Use of predatory mites in commercial biocontrol: current status and future prospects

10:20 - 10:40 Konstantinos SAMARAS, Maria L. PAPPAS, Apostolos PEKAS, Chara KYRIAKAKI, Chara KOLONA, Felix WÄCKERS, George D. BROUFAS

Pollen quality effects on the response of phytoseiid predators against thrips

10:40 - 11:00 Coffee break

11:00 - 12:40 Biological Control and IPM (concurrent sessions)

11:00 - 11:20 Apostolos PEKAS, Cristina NAVARRO-CAMPOS, Altea CALABUIG, Aleixandre BELTRÀ, Felix WÄCKERS

Provisioning of multiple resource supplements to enhance the populations of predatory mites

11:20 - 11:40 Sharon WARBURG, Moshe INBAR, Eric PALEVSKY

Citrus cultivars differentially affects predator species establishment and the outcome of intraguild competition between plant feeding and non-plant feeding phytoseiids

11:40 - 12:00 Marie-Stéphane TIXIER, Martial DOUIN, Serge KREITER

First assessment of biological features of *Typhlodromus (Anthoseius) recki* (Mesostigmata: Phytoseiidae) feeding on *Tetranychus urticae* (Trombidiformes: Tetranychidae)

12:00 - 12:20 Maxime FERRERO, Tony BEN SOUSSAN, Lisa BRANCACCIO, Pascal MIGNET

Testing a new predator installation method in protected cucumber crop in Spain: Predafix^a

12:20 - 12:40 Masaya TANAKA, Junya YASE, Takeshi KANTO, Masahito YAMANAKA, Masahiro OSAKABE

A new physical control of spider mite featuring UVB — Strawberry and carnation

12:40 - 14:00 Lunch

14:00 - 15:20 Biological Control and IPM (concurrent sessions)

- 14:00 - 14:20 Mauro LORENZON, Alberto POZZEBON, Carlo DUSO
Biological control of spider mites in North-Italian vineyards using pesticide resistant predatory mites
- 14:20 - 14:40 Antonios CHRYSARGYRIS, Sotiroula LAOUTARI, Vassilis D. LITSKAS, Menelaos C. STAVRINIDES, Nikolaos TZORTZAKIS
Effects of plant water stress on lavender and Greek sage essential oil quality and biocidal properties against *Tetranychus urticae*
- 14:40 - 15:00 Sebahat K. OZMAN-SULLIVAN, Aysun PEKSEN, Rasim GENÇ, Abbas DULUN
Efficacy of some mushroom extracts against *Tetranychus urticae* Koch
- 15:00 - 15:20 Marine ELADOUZI, Geoffrey CHIRON, Tony DEJEAN, Olivier BONATO, Lise ROY
Characterization of predatory mites assemblages in laying hens farms and potential for biological control

19:30 Welcome Reception

Monday July 11th, Classroom 2.7

10:00 - 10:40 Morphology and Physiology (concurrent sessions)

Moderators: Antonella Di Palma and Elliot W. Kitajima

- 10:00 - 10:20 Charnie CRAEMER, Enrico DE LILLO, Philipp CHETVERIKOV, Ron OCHOA, Gary BAUCHAN
Update and review of knowledge on the mouthparts of the Eriophyoidea (Acari, Trombidiformes, Prostigmata), with particular emphasis on their external morphology
- 10:20 - 10:40 Antonella DI PALMA, Gilberto J. DE MORAES, Beverly S. GERDEMAN, Siegfried HUBER, Elliot W. KITAJIMA, Gerd ALBERTI
The female reproductive system and the insemination mode of the heterozercoid mites (Anactinotrichida, Gamasida, Heterozercinina): ultrastructural, functional and systematic considerations
- 10:40 - 11:00 Coffee break**
- 11:00 - 12:40 Morphology and Physiology (concurrent sessions)**
- 11:00 - 11:20 Norman J. FASHING
Allometric Andropolymorphism in *Eucheyletia* near *bishoppi* (Trombidiformes: Cheyletidae)
- 11:20 - 11:40 Tea ARABULI, Philippe AUGER
Morphological variability in *Bryobia rubrioculus* (Scheuten, 1857) (Acari: Tetranychidae) populations from Georgia (Caucasus)
- 11:40 - 12:00 Sezai ADİL, Sevgi SEVSAY
The morphological abnormalities observed in velvet mites (Acari: Trombidioidea)



- 12:00 - 12:20 Andrey SHATROV
A peculiar secretion of water mites – a new form of arthropod silk
- 12:20 - 12:40 Jaroslav SMRŽ
The nutritional specialization of saprophagous soil mites – important biological and ecological factor for microhabitats selection and sttlement
- 12:40 - 14:00 Lunch**
- 14:00 - 14:20 Makoto ATARASHI, Yuki MANABE, Hidenari KISHIMOTO, Tatsuya SUGAWARA, Masahiro OSAKABE
Protective function of body pigments from oxidative stress in *Panonychus citri*
- 19:30 Welcome Reception**
-

Tuesday July 12th, Assembly Hall

- 09:00 - 9:40 Plenary Lecture**
Mite Systematics: research and education challenges for the future
Marie-Stéphane TIXIER
- 09:40 - 10:40 Taxonomy, Systematics and Phylogeny (concurrent session)**
Moderators: Tobias Pfingstl and Ekaterina Sidorchuk
- 09:40 - 10:00 Consuelo PÉREZ-SAYAS, Beatriz SABATER-MUÑOZ, Tatiana PINA, M^a Antonia GÓMEZ-MARTÍNEZ, Josep A. JAQUES, Mónica A. HURTADO-RUIZ
COI or ITS for Acari barcoding and phylogeny: the importance of DNA markers in species identification and delimitation
- 10:00 - 10:20 Denise NAVIA, Marie-Stéphane TIXIER, Serge KREITER, Francisco FERRAGUT
First molecular phylogeny of the tribe Typhlodromini (Phytoseiidae) inciting a taxonomic reassessment
- 10:20 - 10:40 Victor VICENTE DOS SANTOS, Marie Stéphane TIXIER
Molecular markers for access deep phylogeny in the family Phytoseiidae (Acari: Mesostigmata)
- 10:40 - 11:00 Coffee break**
- 11:00 - 12:40 Taxonomy, Systematics and Phylogeny (concurrent session)**
- 11:00 - 11:20 Marie-Stéphane TIXIER, Victor VICENTE DOS SANTOS, Martial DOUIN, Serge KREITER
Identification polytomous key of Phytoseiidae species (Acari: Mesostigmata) of agronomic interest: an online freely available tool
- 11:20 - 11:40 Julia JAGERSBACHER-BAUMANN
Taxonomic relevance of males in the mite family Scutacaridae
- 11:40 - 12:00 Tobias PFINGSTL, Andrea LIENHARD
Phylogeography of Caribbean intertidal mites (Oribatida, Fortuyniidae and Selenoribatidae) - a challenging project

- 12:00 - 12:20 Sultan ÇOBANOĞLU, Edward Albert UECKERMANN, Hayriye Didem SAĞLAM
A new *Aegyptobia* (Acari: Tenuipalpidae) species on Cupressaceae from Turkey
- 12:20 - 12:40 Sultan ÇOBANOĞLU, Edward Albert UECKERMANN, Hayriye Didem SAĞLAM
Three new record of Tenuipalpidae from Turkey (Acari: Trombidiformes)
- 12:40 - 14:00 Lunch**
- 14:00 - 15:40 Taxonomy, Systematics and Phylogeny**
- 14:00 - 14:20 Evsel DENİZHAN, Işık TEPE, Sultan ÇOBANOĞLU
Eriophyid (Eriophyidae: Acarina) mites on weeds in Van Lake basin
- 14:20 - 14:40 Ivana MARIĆ, Irena MEDO, Dejan MARČIĆ, Philippe AUGER, Alain MIGEON, Maria NAVAJAS, Radmila PETANOVIĆ
Biodiversity of spider mites (Acari: Tetranychidae) in Serbia
- 14:40 - 15:00 Ekaterina SIDORCHUK
Collohmanniidae (Oribatida: Mixonomata) – diverse family with a rich fossil record?
- 15:00 - 15:20 Sultan ÇOBANOĞLU, Cihan CILBIRCIOĞLU
Determination and distribution of garlic bulb mite species (*Allium sativum* L. Alliaceae) in Kastamonu-Turkey
- 15:20 - 15:40 Kamila HRÚZOVÁ, Peter FENĎA
The family Parasitidae (Acari: Mesostigmata) – history, current problems and challenges
- 15:40 - 16:00 Coffee Break**
- 16:00 - 16:20 Taxonomy, Systematics and Phylogeny**
- 16:00 - 16:20 Bilal Saeed KHAN, Muhammad FAROOQ, Muhammad Asif QAYYOUM
Description of a new predatory mite species of the genus *Pseudostigmaeus* (*Pseudostigmaeus solanumus*) Acari: Stigmaeidae from Pakistan
- 17:00 - 18:30 Poster Session**

Tuesday July 12th, Classroom 2.7

- 09:40 - 10:40 Chemical Control, Resistance and Toxicology (concurrent session)**
Moderators: Anastasia Tsagkarakou and İsmail Döker
- 09:40 - 10:00 Aris ILIAS, John VONTAS, Anastasia TSAGKARAKOU
Molecular diagnostics for detecting pyrethroid and abamectin resistance mutations in *Tetranychus urticae*
- 10:00 - 10:20 Deok Ho KWON, Taek Jun KANG, Si Hyeock LEE
Establishment of integrative resistance levels to provide practical management action in *Tetranychus urticae*



- 10:20 - 10:40 Mousaalreza KHALIGHI, Wannas DERMAUW, Nicky WYBOUW, Luc TIRRY, Thomas VAN LEEUWEN
Cross-resistance risk and molecular analysis of complex II inhibitors in the two-spotted spider mite *Tetranychus urticae*
- 10:40 - 11:00 Coffee break**
- 11:00 - 11:40 Chemical Control, Resistance and Toxicology (concurrent session)**
- 11:00 - 11:20 İsmail DÖKER, Cengiz KAZAK
Acute and lethal effects of some pesticides to the native population of *Amblyseius swirskii* (Acari: Phytoseiidae) collected from a commercial citrus orchard
- 11:20 - 11:40 L.M.S. ATAIDE, Maria L. PAPPAS, M.V.A. DUARTE, C.R. DIAS, B.C.J. SCHIMMEL, J.M. ALBA, M.W. SABELIS[†], A. PALLINI, A.R.M. JANSSEN, M.R. KANT
Jasmonate defenses operate against target and non-target mites
- 12:40 - 14:00 Lunch**
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Wednesday July 13th, Assembly Hall

- 09:00 - 09:40 Plenary Lecture**
Low Temperature SEM: an ACARI window
Ronald OCHOA
- 09:40 - 10:40 Special Session**
Climate change and bioinvasions as interconnected challenges
Moderators: María NAVAJAS, Denise NAVIA and Menelaos STAVRINIDES
- 09:40 - 10:00 Maria NAVAJAS, Menelaos STAVRINIDES
Biological Invasions in Changing Ecosystems
- 10:00 - 10:20 Denise NAVIA, Francisco FERRAGUT
Neotropical phytophagous mites in Europe – current and potential invasions
- 10:20 - 10:40 Ronald OCHOA, Cal WELBOURN, Jurgen OTTO, Denise NAVIA, Maria NAVAJAS, Francisco FERRAGUT, Gary R. BAUCHAN
Detection and identification of invasive mites and regulatory measures: a global overview
- 10:40 - 11:00 Coffee break**
- 11:00 - 12:20 Special Session**
Climate change and bioinvasions as interconnected challenges
Moderators: María NAVAJAS, Denise NAVIA and Menelaos STAVRINIDES
- 11:00 - 11:20 Koichi GOKA
Environmental change and biological invasion in Japan – how we should encounter increasing invasive alien species?
- 11:20 - 11:40 Eliot W. KITAJIMA, Juliana FREITAS-ASTÚA, Denise NAVIA
Increasing risks for the expansion of *Brevipalpus*-transmitted viruses under global warming condition

- 11:40 - 12:00 Miguel G. XIMÉNEZ-EMBÚN, Alain MIGEON, Philippe AUGER, Felix ORTEGO, Maria NAVAJAS, Pedro CASTAÑERA
Effect of drought stressed plants on spider mites and impact on outbreaks
- 12:20 - 12:20 Vassilis LITSKAS, Alain MIGEON, Maria NAVAJAS, Marie-Stéphane TIXIER, Menelaos C. STAVRINIDES
Climate change alters biogeography of spider mites and their natural enemies: consequences for biological control and food production
- 12:20 - 12:40 Cultural Acarology**
Of mites and women
Carlos H.W. FLECHTMANN
- 12:40 - 14:00 Lunch**
- 14:00 - 15:40 Field Ecology and Population Dynamics**
Moderators: Sebahat Ozman-Sullivan and Miguel G. Ximénez-Embún
- 14:00 - 14:20 Elif AYSAN, Nabi Alper KUMRAL
The tritrophic relationships among tomato varieties, tomato rust mite and its predators
- 14:20 - 14:40 Miguel G. XIMENEZ-EMBUN, Joris J. GLAS, Felix ORTEGO, Juan M. ALBA, Pedro CASTAÑERA, Merijn R. KANT
Drought Stress in Tomato Plants increases the performance of the tomato russet mite, *Aculops lycopersici*
- 14:40 - 15:00 Ghais ZRIKI, Marie-Stéphane TIXIER, Martial DOUIN, Marc GUISSSET, Julien THIERY, Serge KREITER
Effects of landscape environment and pollen spilled on the density and diversity of predatory mites (Acari: Mesostigmata, Phytoseiidae) in vineyards of South of France
- 15:00 - 15:20 Carlos A. VILLARROEL, Wim JONCKHEERE, Juan M. ALBA, Joris J. GLAS, Wannes DERMAUW, Michel A. HARING, Thomas VAN LEEUWEN, Robert C. SCHUURINK, Merijn R. KANT
Effector proteins of spider mites improve their performance by plant defense manipulation
- 15:20 - 15:40 Anna SENICZAK, Stanislaw SENICZAK, Ivan GARCÍA-PARRA, Francisco FERRAGUT, Pilar XAMANÍ, Radomir GRACZYK, Rafael LABORDA, Eugenia RODRIGO
Oribatid mites of conventional and organic vineyards in Valencian Community, Spain
- 15:40 - 16:00 Coffee Break**
- 16:00 - 17:00 Field Ecology and Population Dynamics**
- 16:00 - 16:20 Kenan KALAY, Sebahat K. OZMAN-SULLIVAN
Seasonal densities of storage mites in wheat flour mills in Samsun Province, Turkey
- 16:20 - 16:40 Ioana NAE, Augustin NAE, Rodica PLĂIAȘU, Raluca Ioana BĂNCILĂ
Effects of habitat type on oribatid mite (Acari: Oribatida) communities structure in Southern Carpathians, Romania
- 16:40 - 17:00 Tomasz MARQUARDT, Sławomir KACZMAREK, Małgorzata CHUDAŚ
Oviposition, ontogeny and population growth of *Trichouropoda ovalis* (C.L. Koch, 1839) (Acari: Mesostigmata: Uropodina: Trematuridae) under laboratory conditions
- 20:00 Gala Dinner**



Thursday July 14th, Assembly Hall

09:00 - 09:40 Plenary Lecture

Acarine C.S.I.: The Show, The Legal System and The Mites

Dr. Lee GOFF

09:40 - 10:40 Special Session (concurrent session)

Forensic Acarology

Moderators: María Alejandra PEROTTI and Barry O'CONNOR

09:40 - 10:00 The threat of predatory journals to acarologists

Henk BRAIG

10:00 - 10:20 Kirsten FARNCOMBE, Henk BRAIG, M. Alejandra PEROTTI

Reviewing the house dust mite fauna: Its value as indoor trace evidence

10:20 - 10:40 Naila A. CHE KAMARUZAMAN, M. Alejandra PEROTTI

Seasonal abundance of mite markers of decomposition stages

10:40 - 11:00 Coffee break

11:00 - 12:40 Special Session (concurrent session)

Forensic Acarology

Moderators: María Alejandra PEROTTI and Barry O'CONNOR

11:00 - 11:20 Jasdeep RAI, Anders LINDSTRÖM, Jens AMENDT, M. Alejandra PEROTTI

The mite fauna of graves and the use of mites as forensic indicators in two case studies

11:20 - 11:40 Medjedline HANI, Henk R. BRAIG, M. Alejandra PEROTTI

Traces of before death: Survival of mites in relocated wrapped bodies

11:40 - 12:00 M. Alejandra PEROTTI, Ildikò SZELECZ

Mites as trace evidence in a homicide case in Switzerland

12:00 - 12:20 Marta I. SALOÑA-BORDAS, M. Alejandra PEROTTI

Ticks and corpses

12:20 - 12:40 Barry O'CONNOR

New observations on carrion-associated mites in North America

12:40 - 14:00 Lunch

14:00 - 15:40 Genetics and Evolutionary Acarology (concurrent session)

Moderators: Denise Navia and Enrico De Lillo

14:00 - 14:20 Valdenice M. NOVELLI, M. Andréia NUNES, Renata S. de MENDONÇA, Juliana FREITAS-ASTÚA, Thais Elise SINICO, Yao-Cheng LIN, Phuong LE, Yves VAN DE PEER, Denise NAVIA

Genome annotation of the flat mite *Brevipalpus yothersi* Baker (Tenuipalpidae)

14:20 - 14:40 Amal Mohsan H. AL-KHALIFY, Michael HEETHOFF, Henk R. BRAIG

Beating DNA out of mites

14:40 - 15:00 Patrizia Elena VANNUCCHI, A. Jesús MUÑOZ-PAJARES, Andy FS TAYLOR

Effectiveness of COI as a barcode for oribatid mites

15:00 - 15:20 Laura M. STEFAN, Elena GÓMEZ-DÍAZ, Jacob GONZÁLEZ-SOLÍS, Karen D. McCOY

Contrasting patterns of diversity and genetic structure in feather mite communities of *Calonectris* shearwaters

- 15:20 - 15:40 Domenico VALENZANO, Valeria MALAGNINI, Enrico DE LILLO, Pasquale SALDARELLI, Carlo DUSO, Valeria GUALANDRI
Preliminary data on the relationship between *Colomerus vitis* (Acari: Eriophyidae) and Grapevine Pinot gris virus (GPGV) and population mite composition in Italy
- 15:40 - 16:00 Coffee Break**
- 16:00 - 17:00 Round Table**
Ignorance of Acarology undermines research validity
Moderator: María Alejandra PEROTTI
- 16:00 - 16:10 Henk BRAIG
Zombie papers
- 16:10 - 16:20 María Alejandra PEROTTI
Introduction to the round table discussion
- 16:20 - 17:00 Round Table Discussion
- 17:30 - 19:00 Poster Session**

Thursday July 14th, Classroom 2.7

- 09:40 - 10:40 Biogeography and Biodiversity (concurrent session)**
Moderators: Elizabeth Hugo-Coetzee and Thomas Bolger
- 09:40 - 10:00 Zoë LINDO
Status of the Peloppiidae (Oribatida) of North America
- 10:00 - 10:20 Levan MUMLADZE, Maka MURVANIDZE, Nino TODRIA
Micro scale species richness of oribatid mites - implications for sampling strategy
- 10:20 - 10:40 Riikka ELO, Ritva PENTTINEN, Jouni SORVARI
Studies of the oribatid mites inhabiting ant nest mounds and their success during habitat disturbance
- 10:40 - 11:00 Coffee break**
- 11:00 - 12:40 Biogeography and Biodiversity (concurrent session)**
- 11:00 - 11:20 Elizabeth HUGO-COETZEE
Distribution patterns of microarthropods on sub-Antarctic Marion Island across altitude and aspect: climate change implications
- 11:20 - 11:40 Elena GAGNARLI, Roberto NANNELLI, Marisa CASTAGNOLI, Giuseppino SABBATINI PEVERIERI, Matteo PERRONE, Silvia GUIDI, Donatella GOGGIOLI, Franca TARCHI, Lorenzo CORINO, Sauro SIMONI
Biodiversity of soil mites in terraced vineyards in Cinque Terre National Park
- 11:40 - 12:00 Salih DOĞAN, Meryem BİNGÜL, Nusret AYYILDIZ, Ozan Arif KESİK
An evaluation in terms of urban mite (Acari) diversity: some mites in peridomestic habitats of Erzincan city (Turkey)
- 12:00 - 12:20 Peter FENDA, Kamila HRÚZOVÁ
Mites (Acari, Mesostigmata) in urban green of Bratislava (Slovakia)



- 12:20 - 12:40 Thomas BOLGER
The Irish Mesostigmata and Oribatida fauna – clues to the origins of the Irish forest fauna
- 12:40 - 14:00 Lunch**
- 14:00 - 14:40 Biogeography and Biodiversity (concurrent session)**
- 14:00 - 14:20 Robin MCARTHUR, Dave GOULSON, Maria Alejandra PEROTTI
Review of bumblebee-associated mite literature
- 14:20 - 14:40 Sauro SIMONI, Gino ANGELI, Mario BALDESSARI, Carlo DUSO
Effects of *Aculus schlechtendali* (Acari: Eriophyoidea) population densities on Golden Delicious apple production
- 15:40 - 16:00 Coffee Break**
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Friday July 15th, Assembly Hall

- 09:00 - 11:00 Behavioural Ecology and Life History Strategies (concurrent session)**
Moderators: Peter Schausberger and Yukie Sato
- 09:00 - 09:20 Peter SCHAUSBERGER, Michael SEITER, Stefan PENEDER, Marliza B. REICHERT, Inga C. CHRISTIANSEN
Proximate variability of early learning in foraging predatory mites
- 09:20 - 09:40 Andreas WALZER, Nathalia LEPP, Peter SCHAUSBERGER
Compensatory growth following transient intraguild predation risk in predatory mites
- 09:40 - 10:00 Hatsune OTSUKI, Shuichi YANO
Predator-prey interactions among mites in an open environment I: learned within-patch oviposition site shift promotes predator patch-leaving
- 10:00 - 10:20 Shuichi YANO, Hatsune OTSUKI
Predator-prey interactions among mites in an open environment II: further interactions between spider mite and predatory mite offspring
- 10:20 - 10:40 Lena DITTMANN, Andreas WALZER, Peter SCHAUSBERGER
Thermal sensitivity of *Amblydromalus limonicus* regarding its establishment potential in Austria under climate warming
- 10:40 - 11:00 Yukie SATO, Peter T. RÜEHR, Helmut SCHMITZ, Martijn EGAS, Alexander BLANKE
Age-dependent male mating tactics in a spider mite from a life history perspective
- 11:00 - 11:20 Coffee break**
- 11:20 - 12:00 EURAAC Meeting**
- 12:00 - 12:40 Closing Ceremony**

Friday July 15th, Classroom 2.7

09:00 - 10:40 Medical and Veterinary Acarology (concurrent session)

Moderators: Christoph Krull and Cristian Vidal-Quist

09:00 - 09:20 Rakhima ZHAXYLYKOVA

Undiagnosed Demodecosis is one of the causes of failures of clinical medicine of the early 21st century

09:20 - 09:40 Cristian VIDAL–QUIST, Félix ORTEGO, Pedro CASTAÑERA, Pedro HERNÁNDEZ–CRESPO

Quality control of house dust mite allergenic extracts through the study of allergen-related enzymatic activities

09:40 - 10:00 Christoph KRULL, Bettina BÖHME, Sarah PRÖHL, Ard NIJHOF

In vitro feeding of hard ticks: Studies on *Ixodes ricinus* and *Dermacentor reticulatus*

11:00 - 11:20 Coffee break



SCIENTIFIC PROGRAM: POSTER PRESENTATIONS

Tuesday July 12th, Exhibition Room 1 (Ground floor)

Morphology and Phisiology

MP-1 Eleazar BOTTA, Sergio REY

A description of teratologies in the *Dermatophagoides pteronyssinus* (Acari: Pyroglyphidae) house dust mite species

MP-2 Jessica GUY, M. Alejandra PEROTTI

Maternally transmitted *Wolbachia* in predatory Phytoseiidae mites used as biological controls

Taxonomy, Systematic and Phylogeny

TS-1 Marcel Santos de ARAUJO, Antonella DI PALMA

New species of *Opilioacarus* from Italy (Parasitiformes: Opilioacaridae)

TS-2 Marcel Santos de ARAUJO, Antonella DI PALMA

New species of *Heterozercion* from Brazil (Parasitiformes: Heterozercionidae)

TS-3 Reyhan ZOROĞLU, Nusret AYYILDIZ

Taxonomic investigations on achipteriid mites (Acari, Oribatida, Achipteriidae) of the Harşit valley from Turkey

TS-4 Mohammad BAGHERI, Mansoureh AHANIAZAD, Mohammad Ali AKRAMI

Introducing of some oribatid mites (Acari: Oribatida) of Maragheh and Bonab regions, Iran

TS-5 Ioana Cristina CONSTANTINESCU, Gabriel CHIŞAMERA, Khlor B. MUKHIM, Costică ADAM

Feather mites fauna (Acariformes: Analgoidea and Pterolichoidea) of Meghalaya (India)-preliminary data from three scientific expeditions

TS-6 Domenico VALENZANO, Patrizia MARTINI, Sauro SIMONI, Enrico DE LILLO

Phyllocoptes cacolyptae (Acari: Trombidiformes: Eriophyoidea), a new eriophyid mite of eucalyptus (*Eucalyptus* spp., Myrtaceae) in Liguria

TS-7 Sibel DİLKARAOĞLU, Salih DOĞAN, Orhan ERMAN, Sevgi SEVSAY, Sezai ADİL

A newly recorded mite species from Turkey: *Eupalopsellus deformatus* Fan (Acari: Eupalopsellidae)

TS-8 Sibel DİLKARAOĞLU, Salih DOĞAN, Orhan ERMAN, Sevgi SEVSAY, Sezai ADİL

A new locality of *Stigmaeus kelkitensis* Dönel & Doğan (Acari: Stigmaeidae)

TS-9 Sibel DİLKARAOĞLU, Salih DOĞAN, Orhan ERMAN, Sevgi SEVSAY, Sezai ADİL

An additionally known member of the genus *Barbutia* (Acari: Barbutiidae) from Turkey: *Barbutia iranensis* Bagheri, Navaei & Ueckermann

TS-10 İsmail DÖKER, Cengiz KAZAK, M. Mete KARACA, Kamil KARUT

Comments on the identity of *Kampimodromus ragusai* Swirski & Amitai, (Acari: Phytoseiidae)

TS-11 Emre İNAK, Sultan ÇOBANOĞLU

The mites species (Acari : Phytoseiidae) on vineyards of Turkey

- TS-12 Nabi Alper KUMRAL, Sultan ÇOBANOĞLU, Marie Stephane TIXIER, Victor VICENTE DOS SANTOS
A preliminary comparative study on morphological and molecular characters of *Typhlodromus* (*Typhlodromus*) *athiasae* and *Typhlodromus* (*Anthoseius*) *recki* from Turkey
- TS-13 Andrea LIENHARD, Günther KRISPER
Take a closer look! *Caleremaeus* (Oribatida, Caleremaeidae): An underestimated taxon
- TS-14 Andrea LIENHARD, Tobias PFINGSTL
Grenadian *Thalassozetes* (Oribatida, Selenoribatidae)
- TS-15 Sergio LÓPEZ-OLMOS, Francisco FERRAGUT
Preliminary catalogue of the Flat mites (Acari: Tenuipalpidae) from Spain
- TS-16 Parisa LOTFOLLAHI, Enrico DE LILLO, Karim HADDAD IRANI-NEJAD
The *Aceria* species (Acari: Trombidiformes: Eriophyoidea) from southwest of East Azerbaijan province in Iran, with description of two new species
- TS-17 Parisa LOTFOLLAHI, Elnaz MOVAHEDZADE
Palaeosomatid mites (Oribatida: Palaeosomata) from different soil horizons of grassland and agricultural habits in Iran, including a new species of *Adelphacarus*
- TS-18 Jeanette STÅLSTEDI, Andreas WOHLTMANN, Johannes BERGSTEN, Joanna MAKOL
Towards resolving the double classification in *Erythraeus* (Erythraeidae): matching larvae with adults using DNA and rearing
- TS-19 Sevgi SEVSAY, Sezai ADİL, Salih DOĞAN
A new record of the genus *Echinothrombium* Womersley, 1937 (Acari: Microtrombidiidae) from Turkey
- TS-20 Franco LAFFI, Roberto NANNELLI, Enrico DE LILLO, Sauro SIMONI
Mites associated with plants: the Laffi photo-repertoire
- TS-21 Ayşe TOLUK, Nusret AYYILDIZ
New records of the genus *Carabodes* (Acari, Oribatida, Carabodidae) from Turkey
- TS-22 Ayşe YEŞİLAYER, Sultan ÇOBANOĞLU, Melike Hazer UÇAR
Phytoseiid mites (Acari) on ornamental plants of Tokat province

Biogeography and Biodiversity

- BB-1 Nusret AYYILDIZ, Şule BARAN
Oribatid mite (Acari) fauna of Marmara region of Turkey
- BB-2 Adina CĂLUGĂR
Soil mesostigmatid mites as potential tool for bioindication concerning ecological status of forest
- BB-3 Adeilma Nascimento de CARVALHO, Anibal Ramadan OLIVEIRA, Denise NAVIA, Francisco FERRAGUT
Cocoa crop strategies influence the community composition and abundance of predatory mites (Acari: Phytoseiidae)
- BB-4 Pinar GENCER GOKCE, Nihal KILIC, Sultan ÇOBANOĞLU
Determination of harmful mite species (Acarina: Prostigmata) of ornamental plants, deciduous trees and shrubs of Tekirdağ –Turkey
- BB-5 Nihal KILIC, Sultan ÇOBANOĞLU
Plant parasitic mite species (Acarina: Prostigmata) of pome fruit trees of Tekirdag-Turkey



- BB-6 Elena CORRAL-HERNÁNDEZ, J. Carlos ITURRONDOBEITIA, Mark MARAUN
Study of species status and intraspecific variation of oribatid mites in oak forest ecosystems from the Basque Country and Navarra (Spain), using phylogenetic methods
- BB-7 Cengiz KAZAK, İsmail DÖKER, Kamil KARUT
Abundance of the phytoseiid (Acari: Mesostigmata) mites in citrus ecosystems in Adana Province, Turkey
- BB-8 Peter FENDA, Daniel JABLONSKI, Jasna KRALJIK
Zoogeography and phenology of *Hemipteroseius adleri* (Mesostigmata, Otopheidomenidae)
- BB-9 Otilia IVAN
New and uncommon species of Oppiidae (Acari, Oribatida) recorded in Romania
- BB-10 Cynthia RIVERA, Francisco FERRAGUT
Preliminary results on mite fauna associated to plants in gardens and green areas of Valencia, Spain
- BB-11 Jeferson Luiz de Carvalho MINEIRO, Ronald OCHOA, Mario Eidi SATO
Distribution of *Brevipalpus papayensis* Baker (Acari: Tenuipalpidae) in different host plants and locations in the State of São Paulo
- BB-12 Rosa YANES, Naila CHE KAMARUZAMAN, M. Alejandra PEROTTI
Diversity of mites on *Macrothele calpeiana* (Araneae: Hexathelidae)
- BB-13 Michal KOPAČKA, Rostislav ZEMEK, Theodoros I. STATHAKIS, Georgios BROUFAS, Georgios TH. PAPADOULIS
Diversity and abundance of Phytoseiidae (Acari: Mesostigmata) on horse chestnut (*Aesculus hippocastanum* L.) in Greece and the Czech Republic

Field Ecology and Population Dynamics

- FE-1 Héctor ESCOBAR-GARCÍA, Francisco FERRAGUT
Damage, population dynamics and spatial distribution of *Brevipalpus ferraguti* Ochoa & Beard (Acari: Tenuipalpidae) on *Myoporum laetum* (Myoporaceae)
- FE-2 Veronika GERGÓCS
Mite and collembola assemblages influence variously litter decomposition rate of different litter types
- FE-3 Iván GARCÍA-PARRA, Eugenia RODRIGO, Pilar XAMANÍ, Rafael LABORDA, Salvador BERTOMEU, Vicente D. ESTRUCH, Anna SENICZAK, Francisco FERRAGUT
Diversity of soil-dwelling mites (Acari: Mesostigmata), in organic and conventional vineyards in Valencian Community, Spain
- FE-4 Ghais ZRIKI, Philippe AUGER, Alain MIGEON, Marie NAVAJAS
An experimental design to estimate the impact of drought stressed plants on *Tetranychus urticae* fitness parameters

Thursday July 14th, Exhibition Room 2 (Ground floor)

Behavioural Ecology and Life History Strategies

- BE-1 Meryem BİNGÜL, Abdulkadir TAŞDEMİR, Erhan ZEYTUN, Salih DOĞAN, Nusret AYYILDIZ
The relationship between female body size and egg number and size of *Acrotritia ardua* (Koch, 1841) (Acari, Oribatida, Euphthiracaridae)
- BE-2 Rosita MONFREDA, Giovanni BUBICI, Enrico DE LILLO
“Salivary secretions” of Eriophyoids (Acari: Eriophyoidea): further knowledge on the eliciting procedures
- BE-3 Rosita MONFREDA, Domenico VALENZANO, Enrico DE LILLO
Preliminary assay on the survival of Eriophyoidea at stress environmental conditions potentially related to air-dispersal
- BE-4 Evert E. LINDQUIST, Olivier BÉTHOUX, Ninon ROBIN, Ekaterina SIDORCHUK
The first case of mite-on-mite hyperparasitism?
- BE-5 Márcia Cristina MENDES, Karina Araújo dos ANJOS, Fernanda Calvo DUARTE, Felipe Eduardo de Matos GODOI, Shirley Batista de Araujo SILVA, Paulo Henrique Selbmann SAMPAIO
Distribution of Macrochelidae mites in peripheral and central portions of cattle dung

Genetics and Evolutionary Acarology

- GE-1 Abdulhalem Abdulsamad A. JAN, Henk R BRAIG
Genome analysis of *Cheyletus eruditus* (Trombidiformes: Cheyletidae)
- GE-2 Angeliki PASPATI, Joel GONZÁLEZ-CABRERA, Alberto URBANEJA
Promoting adaptability of *Amblyseius swirskii* predatory mites to tomato crop
- GE-3 Satoshi SHIMANO, Simpei F. HIRTA
EST (expressed sequence tag) analysis for finding of enzyme origin in *Nanhermannia* (Nanhermanniidae: Oribatida)
- GE-4 Aris ILIAS, Anastasia TSAGKARAKOU
Genetic diversity in worldwide collections of *Tetranychus urticae* (Acari: Tetranychidae)

Biological Control and Integrated Pest Management

- BC-1 Rana AKYAZI, Reyhan SEKBAN, Mete SOYSAL, S. Zeki BOSTAN
The effectiveness of *Amblyseius swirskii* (Mesostigmata: Phytoseiidae) to suppress *Polyphagotarsonemus latus* (Prostigmata: Tarsonemidae) on tea plant
- BC-2 Rana AKYAZI, Mete SOYSAL, Yunus Emre ALTUNÇ
The prey-stage preferences of *Neoseiulus californicus* (Mesostigmata: Phytoseiidae) to *Tetranychus urticae* (Prostigmata: Tetranychidae)
- BC-3 Rafaelly Cristina Mendonça CHAGAS, Maria Cristina Vitelli QUEIROZ, Mário Eidi SATO
Relative toxicity of pesticides on *Chrysoperla externa* (Neuroptera: Chrysopidae) and *Brevipalpus yothersi* (Acari: Tenuipalpidae)
- BC-4 Saeid Javadi KHEDERI, Mohammad KHANJANI, Mansur GHOLAMI, Enrico DE LILLO
Influence of the Grape erineum strain of *Colomerus vitis* (Acari: Eriophyidae) on the development of some grapevine cultivars of West and South Iran



- BC-5 Marine ELADOUZI, Laurent DORMONT, Bruno BUATOIS, Benoit LAPEYRE, Olivier BONATO, Lise ROY
Response of the Poultry Red Mite (*Dermanyssus gallinae*) to changing VOCs emitted by its host fed with additive repellents.
- BC-6 Mariana SAITO, Juliana FREITAS-ASTÚA, Pedro RAMOS-GONZALEZ, Valdenice M. NOVELLI, Elliot W. KITAJIMA
Detection of Passion fruit green spot virus (PFGSV), a *Brevipalpus*-transmitted virus in the mite vector *B. yothersi*
- BC-7 Aline Daniele TASSI, Elliot Watanabe KITAJIMA
Brevipalpus species found in Coffee ringspot virus (CoRSV)-infected plants in Brazil
- BC-8 Irena MEĐO, Dejan MARČIĆ
Sublethal effects of a *Beauveria bassiana*-based mycopesticide on the two-spotted spider mite (Acari: Tetranychidae)
- BC-9 Asma MUSA, Irena MEĐO, Ivana MARIĆ, Dejan MARČIĆ
Acaricidal and sublethal effects of a *Chenopodium*-based botanical pesticide on the two-spotted spider mite (Acari: Tetranychidae)
- BC-10 Konstantinos SAMARAS, Maria L. PAPPAS, Evangelos FYTAS, Vassiliki MANTALI, Anneta TRIANTAFYLLOU, Georgia TAVLAKI, George D. BROUFAS
Pollen provisioning enhances the performance of *Amblydromalus limonicus* on an unsuitable prey
- BC-11 Maria Cristina Vitelli QUEIROZ, Mario Eidi SATO
Stability of fenpropathrin resistance in *Phytoseiulus macropilis* and cross-resistance in the pyrethroids group

Chemical Control, Resistance and Toxicology

- CC-1 Naciye Sena ÇAĞATAY, Pauline MENAULT, Maria RİGA, John VONTAS, Recep AY
Resistance ratio, detoxification enzyme activity and mutation of *Tetranychus urticae* Koch (Acari:Tetranychidae) in populations of collected from greenhouses in Turkey against abamectin
- CC-2 Naciye Sena ÇAĞATAY, Maria RİGA, John VONTAS, Bayram ÇEVİK, Recep AY
Biochemical and Molecular Characterization of Cypermethrin Resistance in *Tetranychus urticae* Koch. (Acari: Tetranychidae)
- CC-3 Rafael LABORDA, Israel MANZANO, Miguel GAMÓN, Isabel GAVIDIA, Rafael BOLUDA, Pedro PÉREZ-BERMÚDEZ
Acaricidal activity of *Lavandula latifolia* essential oil: effects on mortality and fecundity of two-spotted spider mite
- CC-4 Mario Eidi SATO, Bruce VERONEZ, Rafael Sorrentino Minazzi STOCCO, Maria Cristina Vitelli QUEIROZ, Rafaela GALLEGO
Stability and monitoring of spiromesifen resistance in *Tetranychus urticae* Koch (Acari: Tetranychidae)
- CC-5 Eleftherios ALISSANDRAKIS, Aris ILIAS, Anastasia TSAGKARAKOU
Molecular characterization of pyrethroid resistance in *Varroa destructor* (Acari: Varroidae) populations from Greece

Medical and Veterinary Acarology

MV-1 Ruben FÉLIX TOLEDO, Victor IRAOLA

Domestic mites of Valencian Community in Spain: Influence of climatic and environmental factors

MV-2 Hussien REZK

Population fluctuation of the dried fruit mite, *Carpoglyphus lactis* (Carpoglyphidae) and determination of Aflatoxin level on dried apricot samples obtained from Egyptian markets.



ABSTRACTS: ORAL PRESENTATIONS

Morphology and Phisiology

The morphological abnormalities observed in velvet mites (Acari: Trombidioidea)

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The morphological abnormalities in velvet mites were recorded by many researchers. This study comprises previously unhighlighted morphological abnormalities in Velvet Mites. The specimens were extracted directly from soil and Berlese funnels. Larvae were reared from eggs deposited by adults collected in the field. Abnormalities observed in postlarval forms: In one specimen of *Johnstoniana rapax* shortening of appendages of leg I tibia and tarsus. In one specimens of *Atractothrombium sylvaticum* tumour-like growth on post dorsal side of idiosoma. Abnormalities observed in larvae: The first time, two-legged larvae in Trombidioidea was observed. The larvae of *Allothrombium fuliginosum* were obtained by experimental rearing from a female. 39 of these larvae have two-legged and others 223 larvae normally three-legged. The abnormalities observed in these 39 two-legged larvae: Claperede's organ absent in all. Also, in two larvae, *AL* and *PL* setae abreast; in three larvae, *PL* and *S* setae abreast; in one larvae with three *bs* setae; in five larvae, lack of one of the *PL* setae; in one larvae with extra setae beside of *S* setae; in one larvae with extra setae beside of *AL* setae; in three larvae leg I genu with 4 normal setae; in one larvae, *AL* setae duplicated. The abnormalities observed in larvae three-legged: In one specimen of *Allothrombium fuliginosum* duplicated *AL* setae. In one larva, scutellum divided into two parts and *AL* setae bifurcate. Abnormalities observed in larva of *Atractothrombium sylvaticum*: In 30 larvae, quite small bottom lense of left eye; in seven larvae, lack of bottom lense of left eye. The purpose of this study is to provide new information about abnormalities observed in Trombidioidea.

Morphological variability in *Bryobia rubrioculus* (Scheuten, 1857) (Acari: Tetranychidae) populations from Georgia (Caucasus)

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Surveys were conducted on *Bryobia rubrioculus*, which is one of the widely distributed species among the genus *Bryobia* in Georgia. This species is highly polyphagous but mainly found on plants that belong to the family Rosaceae. The surveys of *B. rubrioculus* were performed in 9 regions across Georgia between 2006 and 2014. Mites were collected in 76 sites from 22 different locations, on 17 host plants. Among them, 6 plants were recorded for the first time as hosts of *B. rubrioculus*: *Malus orientalis* Uglitzk., *Rubus idaeus* L., *Rhamnus pallasii* Fisch. & Mey., *Lycopersicum esculentum* L., *Eryngium* sp. and *Astragalus* sp. These investigations on several Georgian populations of *B. rubrioculus* revealed abnormality in the morphology of the prodorsal projections, as individuals of *B. rubrioculus* usually have four prodorsal projections, two laterals and two anteromedials, each of them bearing one seta distally, we found some specimens that differ from the others by having only three prodorsal lobes. These individuals had a single anteromedial triangular projection bearing only one seta. Among the 403 mite specimens examined during the study, 211 were adult females and 192 were immature stages. We found only 4 adult females bearing an unique anteromedian prodorsal projection and this variation was not observed in juveniles. This obvious variation is found in about 2% of the adults collected from three localities and four different host plants: *Prunus domestica* L., *Prunus cerasus* L., *Corylus colurna* L., *Astragalus* sp.

Protective function of body pigments from oxidative stress in *Panonychus citri*

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Deleterious effects of solar ultraviolet-B (UVB) radiation drive plant-dwelling mites to reside on lower leaf surfaces. However, for *Panonychus citri* substantial portions of individuals occur on upper leaf surface. This nature agrees with the fact that *P. citri* is more tolerant to UVB damage than other spider mites. Biological impact of UVB radiation is caused by directly inducing DNA lesion and oxidative stress by reactive oxygen species. Mites on upper leaf surfaces suffer heat stress, which also causes oxidative stress as well as UVB impact. Major pigment of *P. citri* was a keto-carotenoid, astaxanthin, which is well known antioxidant on the basis of *in vitro* experiments. To evaluate the protective function of body pigments of *P. citri*, we comparatively tested antioxidative activity between wild-type strain (WTS; reddish body colour) and albino strain (ATS; whitish with no astaxanthin). We evaluated the singlet oxygen absorbance capacity (SOAC) for pigment fraction and the oxygen radical absorbance capacity of pigment fraction (L-ORAC) and hydrophilic fraction (H-ORAC). SOAC was higher in WTS than ATS. H-ORAC was not different between them while L-ORAC was higher in WTS, suggesting that antioxidant enzymes played similarly in both WTS and ATS and pigments of *P. citri* removed oxidants efficiently. Then, we measured lipid peroxide accumulated in adult females under the rearing condition 1) at 25°C (control), 2) at 25°C with UVB irradiation (UV treatment), and 3) at 35°C (high temperature treatment). Lipid peroxide was accumulated in both strains reared under UV and high temperature treatments while that was the minimum at 25°C. The accumulation value was higher in ATS than WTS. Although survival ratios in adult females were not different, egg production was abundant in WTS rather than ATS in both UV and high temperature treatments, indicating that astaxanthin effectively protected mites.

Update and review of knowledge on the mouthparts of the Eriophyoidea (Acari, Trombidiformes, Prostigmata), with particular emphasis on their external morphology

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The mouthparts of about 70 species of eriophyoids belonging to the Phytoseptidae, Eriophyidae and Diptilomiopidae have been examined combining various microscopy techniques (low-temperature and variable pressure scanning electron microscopy, transmission electron microscopy, light microscopy and confocal laser scanning microscopy). This study provided new data on the external and internal morphology of these structures. These results are herein presented together with a review on the current knowledge of the eriophyoid mouthparts. Similar to all Acari, the mouthparts of the Eriophyoidea consist of a labrum, subcapitulum, chelicerae and palpi. The subcapitulum accommodates dorsally the stylet-like feeding structures which are housed in a U-shaped subcapitular sheath. The sheath is formed by dorso-laterally elevated lips which are overlapped on the dorsal side and leave the proximal parts of the cheliceral axes exposed. The stylets are flattened and lamellar, at least proximally, and are reported to be five, seven or nine, but only a few species have been studied in this regard. We observed nine stylets: a) two pairs of cheliceral origin: a pair of fixed digits and a pair of thinner movable digits, b) one pair of outer subcapitular stylets, c) one pair of inner subcapitular stylets, d) a stylet-like labrum. Chelicerae and other stylets of Eriophyidae and Phytoseptidae are short and relatively straight, whereas they are longer, extending a short distance forward, then abruptly bent downwards in the Diptilomiopidae. The stylets are thin and they probably act together as a complex structure that, along with the help of saliva, enable piercing of the epidermal cuticle, wall and membrane of the plant cells. The chelicerae have proximally enlarged, bulbous bases and each chelicera of



some species have an exposed dorsal protuberance of various shape and size. Cheliceral setae are absent in the Eriophyoidea, even though sensorial structures have been observed inside these stylets, as well as in the subcapitular sheath and palps. Palps have different shapes and reveal structures and ornamentations which might be additional treats in taxonomy and/or in phylogeny, such as: a) a seta-like structure found antaxially of setae *ep* on the palpcoxal base, b) “gnathosomal interlocking apparatus”.

The female reproductive system and the insemination mode of the heterozerconid mites (Anactinotrichida, Gamasida, Heterozerconina): ultrastructural, functional and systematic considerations

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Heterozerconidae is a poorly known, early derived mite family belonging to Heterozerconina (Monogynaspida, Gamasida (=Mesostigmata)). The systematic position of the group remains controversial because of their uncertain relationship to other members of the Gamasida and little is known about the biology and anatomy of the taxon. Organization and ultrastructure of the female reproductive system are described comparing genera from different geographic areas. In particular the occurrence of podospermy as insemination mode in this family (i.e. males use their spermatodactyl to inseminate the female through secondary insemination pores instead of through the oviporus) was documented. In fact, the presence of a sperm access system, starting with secondary insemination pores and leading to paired sac-like structures where multiple sperm cells are observed, is proved for certain species. Nevertheless, in some genera the females lack the sperm access system while a putative spermatophore was observed attached to the genital plate and sperm cells were detected in the epithelial cells of the vaginal duct. Hence it seems that they are tocospermous (i.e. even though males have a spermatodactyl-like process they still use the female genital opening for sperm transfer given that their females lack a secondary insemination system). So the male apparently transfers the spermatophore using the female oviporus and gluing the spermatophores to the genital shield. Hence the spermatozoa likely move from the vagina into the vaginal duct where they penetrate the epithelium and reach the ovary. In conclusion, it looks like in the same family more than one sperm transfer mode is present in different genera: some are podospermic but others are plesiomorphically tocospermic. Such discovery may be crucial to understand the relationships and evolution of the genera of this family and its wider relationships as well as of fundamental importance for the interpretation of evolution of mating systems in Gamasida.

Allometric Andropolymorphism in *Eucheyletia near bishoppi* (Trombidiformes : Cheyletidae)

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Andropolymorphism, a phenomenon in which more than one male morphology occurs within a species, has been observed in each of the major acarine orders. It is usually characterized by discrete morphological differences that separate males into two, and a few cases four, distinct forms. However, polymorphism resulting from allometric growth (i.e., growth of one body part relative to another body part in which there is a change in relationships of proportions and/or shape), has been reported for only one species, *Eutogenes vicinus* (Cheyletidae). The present study provides a detailed description of allometric andropolymorphism in a second species of cheyletid mite, *Eucheyletia near bishoppi*, a nest inhabitant of the mountain beaver (*Aplodontia rufa*). To compare the relative growth of two components, measurements are converted to logs and the resulting slope from a regression analysis is Huxley's “allometric growth ratio”: a ratio = 1 indicates both components are growing at the same rate (isometry), <1 that the component on the Y axis is growing more slowly than the component on the X axis (negative allometry), and >1 that the X component is growing more rapidly (positive allometry). The most noticeable polymorphic characters of the species under study are found in the gnathosoma, with its length increasing dispro-

portionately to idiosomal length. While variation in idiosomal length as indicated by the coefficient of variation is only 4.8%, for pedipalpal femur length it is 26.2%. A comparison of the relative growth between idiosomal length and pedipalpal femur length reveals an allometric ratio of 3.34, a ratio significantly different from 1.0. The allometric ratios for several other measurable characters are also significantly different from 1.0 (e.g., propodosmal shield width 2.289; leg I length 1.902). The high ratios indicate that the observed polymorphism is due to allometric growth. Potential reasons for allometric andropolymorphism will be discussed.

A peculiar secretion of water mites – a new form of arthropod silk

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It is discovered for the first time that a number of water mite species, for example, *Limnochares aquatica* (L., 1758), *Piona coccinea* (C.L. Koch, 1836), *Limnesia undulata* (O.F. Müller, 1776), *Limnesia maculata* (O.F. Müller, 1776), *Limnesia undulatoidea* (Davids, 1997), *Hydryphantes ruber* (de Geer, 1778) and *Mideopsis orbicularis* (O.F. Müller, 1776), maintaining in the laboratory for several months, produce various amount of particular secretion in the form of long rigid mostly hollow un-branched threads. These threads are similar in their morphology in all studied species and may be generally divided into two dimension categories: thin 730 ± 130 nm, and thick 1–2.5 μ m in diameter. Predominance of different thread types varies in different mite species. Specific staining reveals neither DNA nor microbial walls in the threads' composition. Staining with a Calcofluor White M2R fluorochrome definitely indicates that these threads may be classified as belonging to arthropod silk. Organization of the threads was studied using SEM and TEM and is found to be the simplest one among known silks but highly corresponds to that of other water inhabiting arthropods. The threads are mostly collapsed in SEM, TEM examination of the threads revealed that their walls are composed of fine fibrils of different orientation. The atomic-force microscopy estimates the lower margin of the Young's modulus of the dried threads in 1 GPa that is much stronger than lavalan. The observed silk formation does not match to the mite reproduction activity because lasted from late summer till winter when mites have already completed producing both eggs and spermatophores. Dermal glands are the most probable source of this type of secretion. This study is supported by a grant N 15-04-01203-a from the Russian Foundation for Fundamental Research.

The nutritional specialization of saprophagous soil mites – important biological and ecological factor for microhabitats selection and settlement

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Up until the fifties had published several papers on the poor nutritional specialization of soil saprophagous mites. They had regarded as only mechanical destroyers of litter, moreover with very weak effectivity in that process. But, the following years confirmed the opposite facts. In our laboratory we found the very detailed specialization among those by the application of the microanatomical, mainly histological way, including fluorescence light, culturing of homogenate of mites and isolated associated bacteria from them, enzymological methods, and, of course, of ecological studies. We have established several pattern of feeding habits: litter consumption, mycophagy of several pattern, lichenophagy, bacteriophagy. Many saprophagous mites consume also algae or cyanobacteria. We took also various levels of digestion: *specialists* – the thorough digestion of the special types of food, and, on the other hand, *ubiquists* – imperfekt, somewhat sloppy digestion of the broad scale of food. The populations of latter decrease step by step under the more diversified conditions in competition with the specialists. Moreover, there are many transitional types including so-called *nomads*, which migrate between habitats with various food and an intensity of their digestion is fluctuating according to food offer. Such mites represent the very resistant species against abiotic factors in the contrary to the real specialists. There are also several species able to *adapt* to different food indeed with the thorough digestion of that. So, the feeding habits seems to be strongly diversified among soil saprophagous mites. Therefore the nutritional niches and especially microhabitats or microbiotopes selection are evolved to restrain some nutritional competition between species of saprophagous mites in soil.



Collohmanniidae (Oribatida: Mixonomata) – diverse family with a rich fossil record?

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Collohmanniidae, with five described species, is among both the best and the worst known oribatid mite families. There are dozens of publications, focused on behaviour, reproductive biology, chemistry and morphology of these large litter-dwelling mixonomatans. This is not surprising, for *Collohmannia* species are unique among oribatids in having a coupling ritual, involving transfer of nuptial food from male to female, and are extremely interesting from the systematic and morphological standpoint, being somewhat intermediate between Mixonomata and Desmonomata. Yet there are indications that we know little about their past and present diversity, i.e., their distribution in space and time. Of the five described species in two named (and maybe synonymous) genera, two are Eocene fossils from European Baltic amber, and three are recent, collectively Holarctic, species. *C. gigantea* Sellnick, 1922 (= *C. nova* Sellnick, 1932) occurs in southeastern Europe, *C. asiatica* Krivolutsky et Christov, 1970 is known only from the type locality in Tajikistan, and *C. johnstoni* Norton et Sidorchuk, 2014 is known only from West Virginia, U.S.A. How such a highly disjunctive distribution formed, and when the diversification of Collohmanniidae occurred, is not understood. However, new data on the discovery of at least eight new *Collohmannia* species, both fossil and recent, allow for some new considerations and the anticipation that more will be found in the future.

Determination and distribution of garlic bulb mite species (*Allium sativum* L. Alliaceae) in Kastamonu-Turkey

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The aim of this study was to identify the mite species and their population density attacking garlic bulbs in Kastamonu regions of Turkey. The samples were collected mainly from most important garlic producing and the exporting center (Kastamonu) during 2014–2015. All the obtained mite samples were evaluated in this paper. Frequency of occurrence and rates of intensity of infestations were determined. A total of 14 mite species belonging to 8 genera were identified during the surveys. The pest mites *Rhizoglyphus robini* Claparede (Acari: Acaridae) and *Tyrophagus putrescentiae* (Schrank) (Acari: Acaridae) were the most abundant mite species on garlic bulbs. The infestation rate of these two species was 74.25%. *Cheyletus eruditus* (Schrank) (Acari: Cheyletidae) and *Gamasellodes bicolor* (Berlese) (Acari: Ascidae) were detected as the most common and populated beneficial mites. The taxonomical characteristic of the important harmful mite species and their distribution were provided. This work has been supported by TÜBİTAK TOVAG 114O 416.

A new *Aegyptobia* (Acari: Tenuipalpidae) species on Cupressaceae from Turkey

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Aegyptobia Sayed is the third largest genus of Tenuipalpidae and is represented by 97 species world-wide. This genus is mainly associated with Asteraceae, Cupressaceae, and Chenopodiaceae. Four *Aegyptobia* species are recorded from Turkey. A new *Aegyptobia* species (Acari: Trombidiformes: Tenuipalpidae), namely *A. juniperis*

from *Juniperus horizontalis* (Moench) (Cupressaceae), *Thuja orientalis* L. *Juniperus virginiana* L. cv *skyrocket* (Cupressaceae), *Juniperus media* Van Melle (Cupressaceae) and *Thuja horizontalis* (Cupressaceae), was described from Ankara, in Turkey. The taxonomical importance of all life stage of *A. juniperis*, distribution and host plants are given.

Three new record of Tenuipalpidae from Turkey (Acari: Trombidiformes)

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Members of the family Tenuipalpidae are of economically importance as pests of crops, fruit trees and ornamentals world-wide. They are slow moving and feed on stems, fruits, flowers and near the midrib or veins on underside of the leaves. To date 24 species of Tenuipalpidae are reported from Turkey. Three new records are reported and redescribed for the Turkish fauna, and were collected during surveys in 1999 and between 2005 and 2006. *Brevipalpus rotai* Castagnoli & Pegazzano, 1979 was collected from *Olea europaea* L. (Oleaceae), *Cenopalpus bagdasariani* (Livshitz & Mitrofanov, 1970) was collected from *Populus nigra* L. (Salicaceae) and from *Populus tremula* and *Aegyptobia beglarovi* Livshitz & Mitrofanov, 1967 was collected from *Juniperus horizontalis* Moench (Cupressaceae) from Turkey. Their distribution and host plants are included.

Eriophyid (Eriophyidae: Acarina) mites on weeds in Van Lake basin

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The main goal of this work is to determine Eriophyidae (Acarina: Prostigmata) fauna on weeds in orchard of Van Lake basin during 2013–2015 years. As a result *Aceria anthocoptes* (Nalepa, 1892), *Aceria amaranthi* (Abou-Awad&El-Banhawy, 1992), *Aceria salviae* (Nalepa, 1891), *Abacarus longilobus* (Skoracka, 2002), *Anthocoptes trigonellae* (Denizhan et al., 2009); *Aculops montenegrinus* (Petanovic and De Lillo, 1992); *Abacarus hystrix* (Nalepa, 1896); *Aceria acroptiloni* (Shevtchenko and Kuvalev, 1974); *Aceria balasi* (Farkas, 1960); *Aceria tosichella* (Keifer, 1969), on *Cirsium arvense* L., *Amaranthus* sp. Wict., *Salvia* sp. L., *Bromus* sp. L., *Euphorbia* sp. L., *Trigonella* sp. L., *Agropyron repens* L., *Centaurea depressa* L., *Crupina* sp. L., *Triticum sativum* L.

The family Parasitidae (Acari: Mesostigmata) – history, current problems and challenges

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Systematics of the family Parasitidae is quite complicated and uncertain. There were several revisions made in the last century, which were focused on the family Parasitidae or on the smaller parts of it. Each of these revisions brought partly or completely different view on the systematics of Parasitidae and that resulted in divergent taxonomic concepts. Nowadays, the family Parasitidae is divided into two subfamilies – Parasitinae and Pergamasinae. There are 22 genera in the subfamily Parasitinae, 5 of them were synonymized and 17 are valid. Almost half of them, 7 genera, has not been mentioned in any revision. The number of the genera can be greater because the genus *Parasitus* is divided into 5 subgenera and the genus *Neogamasus* into 3 subgenera, which are listed as separated genera sometimes. Three genera are monospecific. The subfamily Parasitinae has mainly Palearctic



distribution but there are 6 genera which are not widespread in Europe. These genera are widespread in Asia, South America and Africa. Many species of subfamily Parasitinae are phoretic on insect and a trend of ecological specialization of some genera can be observed. There is only 11 valid genera in the subfamily Pergamasinae but the systematics of this subfamily is even more complicated. At least two genera include subgenera, which taxonomic rank is uncertain and most likely will change – within the genus *Leptogamasus* are recognized 3, and within the genus *Paragamasus* 9 subgenera. Only few species of the subfamily Pergamasinae, as well as of Parasitinae, are included in recent identification keys. The subfamily Pergamasinae has a Palearctic distribution. The completely revision of the family Parasitidae is required but the phylogenetic relationships within the family Parasitidae will remain unresolved until we know important characters of some taxa.

Taxonomic relevance of males in the mite family Scutacaridae

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The taxonomy of the mite family Scutacaridae (Heterostigmatina) is exclusively based on the females' morphology. Males as well as larvae (which are the only juvenile stage) are only known for a minor number of species, mainly because of their minute size and soft-skinned nature. In soil samples, males can seldom be found, and if they are present there are usually very few individuals which can rarely be encountered together with the respective females, making it difficult or impossible to assign them to certain species. The most reliable method to identify males is to perform cumbersome laboratory cultures. To date, out of the about 800 known species of Scutacaridae, males have only been described for some 25 species belonging to eight genera. In a present study, the taxonomic importance of scutacarid males has been evaluated for the first time by investigating the power of male morphology to differentiate between species, genera and also between closely related families. Despite the methodological difficulties of retrieving males, the study revealed that it is worthwhile to make the effort to include them in investigations because they can contribute important answers to taxonomic questions.

Description of a new predatory mite species of the genus *Pseudostigmaeus* (*Pseudostigmaeus solanum*) Acari: Stigmaeide from Pakistan

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The taxonomic study of mites comprises a general review of distribution, classification and external morphology. A new species of the genus *Pseudostigmaeus* of the family Stigmaeidae (Prostigmata) was collected during the random survey to explore the mite fauna from Punjab, Pakistan. The holotype and paratype female were collected from eggplant (*Solanum melongena*). The description, illustration of main body parts, host range, evaluating report with comparison remarks are also given in this manuscript.

Biodiversity of spider mites (Acari: Tetranychidae) in Serbia

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Spider mites (Acari: Tetranychidae) are among the most dominant and destructive plant-feeding mites worldwide. Despite their economic impact in agriculture, data on biodiversity are scarce in some regions of Europe, as for example in Serbia as well as in the Balkans. According to the Spider Mites Web database (<http://www1.montpellier.inra.fr/CBGP/spmweb/>), fifteen known species from six genera were until now reported from Serbia. This is a relatively small number of spider mites considering the whole country area, and the geographic and the floral diversity. To improve our knowledge on mite diversity of this region we conducted a survey on 97 different localities in Serbia during three growing seasons (2013-2015). Samples were collected in different habitats: forests, agricultural areas and urban landscapes, as well as in protected natural areas like national parks, nature parks, special and protected areas. We collected samples from 82 different host plants and among these 47 were wild and weed plants and 35 were cultivated plants or plants that are economically important agricultural crops. Species identification was done by using morphological criteria. A total of nine new spider mites species for Serbia were uncovered. These are *Eotetranychus rubiphilus*, *Eotetranychus pruni*, *Eotetranychus fraxini*, *Eotetranychus carpini*, *Eotetranychus aceri*, *Panonychus citri*, *Tetranychus evansi*, *Schizotetranychus garmani* and *Bryobia praetiosa*. While some information does exist of other four genera and six species in Serbia, but without precise information and published data available. These are *Oligonychus* sp., *Tetranychopsis* sp. (*T. horridus*), *Neotetranychus* sp. (*N. rubi*), and *Eurytetranychus* sp. (*E. buxi*), and also *Eotetranychus tillarium* and *Eotetranychus coryli*. The work here presented is the first faunistic study in Serbia conducted on spider mites sampled over the whole country. It represents a valuable first step to better know the biodiversity and distribution of Tetranychidae mites in the Balkans.

First molecular phylogeny of the tribe Typhlodromini (Phytoseiidae) inciting a taxonomic reassessment

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One of the main goals of taxonomic classification is to improve predictive power on different aspects of a particular taxon based on known traits of closely related taxa; therefore it is especially useful if based on the evolutionary relationship among organisms. Predatory mites of the family Phytoseiidae consist in the main group of biological control agents on plants; three subfamilies are recognized in this family. In the Typhlodrominae subfamily, the Typhlodromini Wainstein tribe includes three genera: *Typhlodromus* Scheuten, *Neoseiulella* Muma and *Typhloseiulus* Chant & McMurtry. The most numerous genus *Typhlodromus* (454 spp.) is currently divided in two subgenera *T. (Typhlodromus)* Scheuten and *T. (Anthoseius)* De Leon. Phylogenetic relationships in the tribe Typhlodromini are herein firstly investigated based on four DNA molecular markers which have been defined as informative for supra-generic, generic and specific taxonomic levels in the Phytoseiidae, being three mitochondrial: COI mtDNA (790 bp), CytB mtDNA (428 bp), 12S rRNA (457 bp); and one nuclear ITSS (699 bp). Sequences of specimens from 58 populations from Spain (6 peninsular provinces, Canary Islands and Ibiza), France (Corsica and Reunion Island), Portugal (Azores), Russia, Iran, and USA belonging to at least 25 species in the three Typhlodromini genera and two outgroups tribes (Paraseiulini and Metaseiulini) were obtained. Sequences available in public database (GenBank) were recovered and included in the datasets. Data were analysed using Parsimony and Bayesian approaches, markers were analysed separately as well as combined. *Neoseiulella* genus and *T. (Anthoseius)* subgenera showed to be paraphyletic. Occurrence of cryptic species was observed among populations preliminarily identified as *T. (Anthoseius) rhenanoides* Athias-Henriot and *Neoseiulella litoralis* (Swirski & Amitai). Phylogenetic value of morphological traits is discussed.



COI or ITS for Acari barcoding and phylogeny: the importance of DNA markers in species identification and delimitation

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Traditional identification of Acari relies on external limited diagnostic characters. Those characters usually exhibit large phenotypic plasticity within species rendering them sometimes usefulness for species delimitation and identification. Nowadays, species boundaries have been established by the joint use of morphological, molecular and phylogenetic traits, raising the importance of molecular markers in the taxonomic field. Acari belonging to Tetranychidae and Phytoseiidae families include species of agricultural economic importance. In this study we have incremented the number of sequences in these two Acari groups corresponding to the 3' end of the mitochondrial cytochrome c oxidase subunit I gene (3' COI) and to the nuclear ribosomal DNA Internal Transcribed Spacer (ITS). We have established species boundaries, species barcodes and phylogenetic relationship among several clades of those groups. Comparisons between complete COI and 3' COI, ITS and ITS2 among all Acari sequences obtained in this study and those published in Genbank have demonstrated that the selected regions, even small, provide informative enough positions for both species identification and phylogenetic studies. Our analyses show that Acari is a monophyletic group, on which Astigmata, Ixodida, Mesostigmata, Oribatida and Prostigmata are also monophyletic. Accordingly, sequence identity with a 10% of divergence has been established as species delimitation character, allowing to establish a barcode dataset for Acari identification.

Phylogeography of Caribbean intertidal mites (Oribatida, Fortuyniidae and Selenoribatidae) - a challenging project

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Only a few oribatid mites have managed to conquer the marine littoral area and are now subject to environmental influences imposed by both aquatic and aerial climates. The majority of these mites living in this extreme ecotone belong to the superfamily of Ameronothroidea. The ameronothroid families of Fortuyniidae and Selenoribatidae show a transoceanic distribution but are restricted to coasts of the tropics and subtropics. Until recently, there were only a few vague records suggesting that fortuyniid and selenoribatid mites may also be present on Caribbean coasts. Late investigations confirmed this suggestion and further indicated that these mites may be very common throughout the Caribbean. The well-known geological history of this geographic region provides an ideal framework to study speciation, diversification and dispersal patterns of these intertidal oribatid mites and hence a research project recently started to pursue this aim. First results of this study show that several species of four genera have successfully colonized the coasts of the Netherlands and Lesser Antilles and that certain taxa may show specific habitat preferences. In addition to these preliminary results, logistic as well as methodical challenges of field work within the Caribbean area are highlighted and the current incomplete state of knowledge about the biology and ecology of these animals in general is discussed.

Identification polytomous key of Phytoseiidae species (Acari: Mesostigmata) of agronomic interest: an online freely available tool

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Phytoseiidae family contains many predatory species useful to control phytophagous mites and small insects. For using the biological control potential of these natural enemies, specific diagnosis is of huge importance. Species identification is currently based on morphological characters, the most used being idiosoma and leg setae occurrence and length, spermatheca and shield shapes and chelicera dentition. Despite the importance of these mites for biological control, an identification key of species of agronomic interest in the world does not exist. The existing identification keys apply to Phytoseiidae fauna of a country and/or region, or are dedicated to a taxa group, usually at genus level. First, the present study aims to develop an identification key of the most important species for biological control in the world. Second, it aims to propose a freely available online tool to allow systematic democratisation, avoid errors and improve biological control success. The format chosen is a polytomous key that allows users to begin the identification by any of the characters available; it is also a friendly user tool and pictures to species identified and/or characters targeted are easily accessible. Sixty Phytoseiidae species, corresponding to species used in biological control all over the world on various crops but also to close morphologically species, are included in the key. Forty-four characters were used to construct the key, eighteen being discrete and twenty-six continuous. Construction of the key is explained. For each species, data on geographical distribution, some aspects of biology (especially in a framework of biological control) and pictures (based on own picture gallery or original descriptions) are provided. The tool is available at the following address: <http://www1.montpellier.inra.fr/CBGP/phytoseiidae/polytomouskeyagronomicspecies.htm>.

Molecular markers for access deep phylogeny in the family Phytoseiidae (Acari: Mesostigmata)

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The resolution of deep nodes improves backbone phylogeny and significantly contribute to better understand taxa evolution. The study focuses on the mite family Phytoseiidae. Mitochondrial markers (COI, CytB, 12S rRNA) and the nuclear marker ITSS are reported to be suitable for resolving specific level and amplification/sequencing protocols are now currently used for this family. However, when considering supra-specific levels and relationships between genera and sub-families, little efficient markers are reported in literature, hindering deep phylogenetic study. The present thus aims to characterize the efficiency of two molecular markers (28S and HSP90: Heat Shock Protein) used for resolving deep nodes in mites and insects. For reflects the diversity of each sub-family, seventeen Phytoseiidae species belong to ten genera dispatched in the three Phytoseiidae sub-families (Amblyseiiinae, Typhlodrominae and Phytoseiinae) were considered in this study. Furthermore, this selection of species and genera determines the suitability of molecular markers to assess phylogenetic relationships between species of a same genus, several genera within a tribe and between the three sub-families. First, tests for adapting amplification protocols have been carried out. Second, phylogenetic analyses have been carried out to determine the efficiency of each marker to resolve deep nodes based on several indexes. Both markers show great efficiency for resolving different taxonomic levels (species, genus, tribe and subfamilies). Concatenated analysis, including other markers, show that both 28S and HSP90 greatly improve the phylogenetic signal (high resolution of nodes), thus providing greater robustness and credibility of the phylogenetic tree obtained. Discussion on paraphyly and polyphyly of some taxa are discussed.



The Irish Mesostigmata and Oribatida fauna – clues to the origins of the Irish forest fauna

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Colonisation of an island is typically determined by its size, degree of isolation and its geological and quaternary history. The timeframe for the colonisation of Ireland has largely been determined by the extent and retreat of the ice sheet at the end of the Last Glacial Maximum. Superimposed on this quaternary history is the fact that, although forest is the climatic climax vegetation for most of Ireland, the total forested area had declined to only 1.4% by 1905. Now however, forests cover approximately 10% of the country but more than 90% of the forests are plantations North American species such as Sitka spruce. Given that Ireland was essentially totally deforested and given the comparatively poor dispersal ability of mites, it would be interesting to know the composition and potential biogeographical origins of the Irish forest fauna. The acarine fauna of Ireland has been studied intermittently for approximately one hundred years and there are currently over 200 species of Oribatida and approximately 350 species of Mesostigmata recorded from the island. These records have derived from the pioneering studies of Halbert, through extensive studies of agricultural and peatland systems and, latterly, from studies of the fauna of forests and some coastal habitats. In this paper records of the fauna, collected over the past century, have been collated and analysed in an attempt to determine the extent of the distinctiveness of the fauna of the main habitat types in Ireland and in an attempt to gain clues as to the origins of the Irish forest fauna. Preliminary analysis suggests that many species have high indicator values for particular habitat types and that between 7 and 10 species appear to occur exclusively in each of the major habitat types examined. The fauna of the forests appears most similar to that of peatlands and most distinct from that of grasslands.

An evaluation in terms of urban mite (Acari) diversity: some mites in peridomestic habitats of Erzincan city (Turkey)

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Urbans as living spaces are human ecosystems, which mean many natural and cultural factors in a combination and interaction. Plants and animals living in the built environment give us information about the urban biodiversity. The urban biodiversity is explained as richness of living organisms including genetic variation and habitat diversity found in and on the edge of human settlements. A variety of species live in urban area having different and mixed habitats: forested areas, streams, rivers, arable fields, residential areas such as gardens, parks, greenspaces, woodlands etc. Urban biodiversity as a key component of ecosystems have positive effect on quality of life as well as environmental improvement. The greatest impact of the urbanization on the biodiversity is on habitats. Loss of natural vegetation due to urban development, the spread of non-native exotic species and loss or fragmentation of natural areas or isolating are losses on many livings in habitats. A large number of different species including mites live in peridomestic habitats in the urban environment. Peridomestic habitats are outside, around the perimeter of man-made shelters and structures. They include the external surfaces of buildings, the ornamental trees, shrubs and turfgrass. Create awareness on sustainable development and protection of urban ecosystems makes important determining and conservation of the city biodiversity. The aim of this study is to reveal the mites diversity in peridomestic habitats of center of Erzincan which is a city located at the crossroads of Eastern, North Eastern and Central Anatolia regions. To this end, in the city center, during October 2014 – March 2016, the samples of soil, litter and moss were taken from the areas (the gardens of homes and public institutions, green areas, parks, the wall sides, sidewalks bottoms, etc.) that are suitable living environment for the mites. The mites in these samples were extracted using Berlese funnels. In the scope of work, a total of 61 mite species belonging to 21 families in Oribatida and Raphignathoidea (Prostigmata) were identified. Their dispersion areas were mapped by Geographical Information System (GIS). It was understood that Erzincan center is rich in mite diversity. In conclusion, the

diversity of landscape-based habitats and the presence of many separate houses with garden in the city support considerably the biodiversity. It can be expected that this study will contribute to the protection of local biological diversity of the city and to reveal the mite diversity of Erzincan city in which the urban renewal activities increase.

Studies of the oribatid mites inhabiting ant nest mounds and their success during habitat disturbance

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The soil-dwelling oribatid mites are one of the most numerous, yet little studied, ant associates. Recently, our study in Finland based on 10,600 specimens and 74 identified species, showed that the wood ant *Formica polyctena* nest mounds were inhabited by an equally abundant and diverse oribatid fauna as the surrounding soil. Moreover, the results revealed that predominantly different species inhabited these two habitats. Therefore, as the red wood ants build large, dense and long-lived nest mounds in boreal forest, their nests are important factors in maintaining oribatid biodiversity. For associates, the benefits of living within ant nests are access to organic mound material as a food resource, and favourable temperature and moisture conditions, which are essential for ectothermic animals. Forest management practices, such as clear-felling, affect the physical properties of mounds which may be harmful not only for ants, but also for their rich associate fauna. Forest clear-felling exposes mounds to direct sunlight and increased wind which may cause drying of the nest's microclimate and temperature fluctuation. Indeed, our recent study revealed that i) nests of *Formica aquilonia* were significantly drier in clear-fells than in forest, and ii) mounds were cooler in clear-fells, indicating that humidity has a function in mound thermoregulation. Changes in these properties could have effects on the decomposer fauna such as oribatids, and thus also on the rate of decomposition and recovery of an ecosystem after habitat disturbance. In our ongoing study we investigate the effects of forest clear-felling, i.e. the drying and cooling of mounds, on the oribatid fauna living in ant nests by comparing abundance, diversity and community composition in natural forest mounds and clear-fell mounds. Based on the distribution of 17,100 specimens, preliminary results indicate that the amount of oribatids is not reduced in clear-fell mounds, but diversity is.

Mites (Acari, Mesostigmata) in urban green of Bratislava (Slovakia)

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Occurrence of mesostigmatid mites (Acari, Mesostigmata) in urban areas of Bratislava city (Slovakia) was examined. We studied relatively undisturbed sites in urban agglomeration (six cemeteries and park in botanical garden), where we found 123 species (10,306 individuals during three-year research). In cemeteries, where the dryness, the missing or the poorly litter layer constitute apparently unfavourable conditions for development of mite populations, we recorded 4 species new for the fauna of the Slovak Republic (*Asternoseius ciliatus*, *Sejus posnaniensis*, *Parasitus americanus* and *Evimirus uropodinus*). This work was financially supported by KEGA grant No. 059UK-4/2014.

Biodiversity of soil mites in terraced vineyards in Cinque Terre National Park

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The Cinque Terre (Liguria, Italy) is a coastal zone with terraced hills managed for viticulture and declared UNESCO Cultural Heritage site. As a contribution to knowledge of the biodiversity in this protected area, the present study on free-living soil mites, generally the most abundant group of microarthropods, can be considered in the evaluation of soil quality. The acarofauna, among several roles, regulates the decomposition rate, affects nutrient cycling and soil fertility. Over two years, five samplings were carried out in five vineyards: from 50 to 400m ASL, ordered by increasing altitude, Manarola, Corniolo, Fossola, Groppo, Porciana. For each site, five soil samples (about 250cm³) were collected; microarthropods were extracted with Berlese-Tullgren funnels and observed by a stereomicroscope. The abundance of soil mites were determined and analyzed by Anova; biodiversity was evaluated by the main ecological indexes. Mite community represented the main group (56.6%) of total microarthropods collected (>6,700 specimens). The abundance of oribatids was the highest (N=1763) and was affected by sampling sites ($F_{4,111}=3.38$; $P=0.012$). Twenty-seven families of Oribatida (42 species), 20 families of Prostigmata and 9 of Mesostigmata (29 species) were determined. The Shannon index (H) applied to oribatids showed maximum value ($H=2.1$) in Porciana and quite high values in the other sites; considering the Mesostigmata, H values were always >2 with the exception of the vineyard in Groppo. In the vineyards considered, density and diversity in the Acari were higher than other agroecosystems. The community structure, with richness in species of Oribatida as soil decomposers and Mesostigmata as predators, give good indication of the complexity of the soil biota.

Distribution patterns of microarthropods on sub-Antarctic Marion Island across altitude and aspect: climate change implications

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Current climate change is altering species distributions. One approach to predict future species distributions is to examine the distribution of species across altitude. Current distribution patterns of species at cold, high altitudes may change with increasing temperature and may eventually resemble the species distribution patterns currently observed at warm, low altitudes. Climate changes have been observed over the past 50 years on sub-Antarctic Marion Island, with an increase in mean annual temperature and a decrease in mean annual precipitation. In this study, the distribution patterns of mites and springtails inhabiting the cushion-plant, *Azorella selago*, across altitude and on different sides of the island were studied. Furthermore, since species might not only respond to environmental factors, but also to specific habitat variables, the relationship between microarthropods and plant characteristics were examined. Mite and springtail species richness and springtail abundance were significantly higher on the western side of the island, which receives more rainfall and has higher percentage cloud cover than the eastern side. Mite abundance did not show a significant trend, which may be due to the higher desiccation tolerance of mites. Mite and springtail species richness and springtail abundance were significantly lower at high altitudes coinciding with the decrease of temperature and habitat diversity towards higher altitudes. Plant characteristics generally did not contribute to explain species richness and abundance, which indicate that at the island-wide scale abiotic, rather than biotic factors appeared to be a more important determinant of patterns in species distribution and community structure. Although predictions cannot be made for all species, because species respond individualistically to climate change, in general it is clear from this study that a warmer and drier climate will change the microarthropod community structure within *A. selago* on Marion Island dramatically.

Status of the Peloppiidae (Oribatida) of North America

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Members of Peloppiidae are found throughout the Holarctic in temperate and boreal forests, and while common, are rarely collected in high abundance. By contrast, Pacific Northwest forest habitats of western Canada have high relative diversity of peloppiid mites representing species of the genera *Ceratoppia*, *Dendrozetes*, *Metrioppia* and *Parapyroppia*. Many of these fauna are newly described species that are seemingly endemic to the region. Here I present the status of Peloppiidae from western North America, introduce seven recently described species (five new species of *Ceratoppia*, one new species of each *Dendrozetes* and *Metrioppia*), their ecology and distri-

butions, and relationships among the family based on molecular sequence data for the mitochondrial cytochrome oxidase subunit I (COI). Despite this recent effort, quite a bit of work remains for the Peloppiidae of North America. Within the genus *Ceratoppia* three widely-distributed and established species have considerable morphological variation, many older type specimens are missing or destroyed, and there are at least three undescribed species of *Ceratoppia* in the Canadian National Collections (Ottawa, Ontario). For other genera, there is at least one new species of *Parapyropia* from central and eastern Canada, species within the *Paenoppia Metapyropia* and *Pyropia* require resolution of their status, and descriptions for immatures known at genus level are necessary.

Review of bumblebee-associated mite literature

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This work summarises an investigation of literature published over the last 130 years relating to mites associated with bumblebees, with the aim of rescuing original information on the nature of these associations. This review focuses on 6 major areas of the literature on this subject: 1) The described effects (or lack thereof) of mites on their bumblebee associates, with particular focus on the limitations of the current literature in this area. 2) The biogeographical regions where certain mite species have been found, and the lack of research available on this subject in certain areas of the planet. 3) Known associations between mite species and bumblebee species with regard to the specificity of these relationships, and other environments where bumblebee-associated mites are found. 4) Some aspects of the biology of these mite species, particularly their feeding habits and synchronisation of life cycles with their bumblebee associates. 5) Issues regarding mite identification, its potential inaccuracy, and in some cases its incompleteness within the literature on this subject. 6) The spread of mite species around the globe as a result of human activities, the known effects of these introductions on the native fauna, and efforts being made to limit introductions of foreign mite species in the future.

Micro scale species richness of oribatid mites - implications for sampling strategy

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In order to study diversity and community ecology of oribatid mites, researchers are relying on soil cores of different volumes and different numbers of subsamples taken within the area. There is no well defined protocol which would define maximal effective core size or number of soil samples per area and there is surprisingly low number of studies that address this question. Even more, there is no agreement between scientists on which approach is better for qualitative soil sampling: to collect single sample with large volume or several small sized samples. Unstandardized sampling makes it difficult to assess sampling efficiency and to compare spatially or temporarily different sampling results. In order to determine effective size of soil sample for finding maximal number of species, we conducted field experiment in meadow ecosystem. We applied nested sampling design where smallest unit was 5cm² area with depth of 10 cm and by each try total area was increased by 5cm² until complete sample size reached 25cm² with the depth of 10cm (4 replicates). The results (based on rarefaction analyses) show that even within 25 cm² area new species are still emerging and the cumulative graph of the species number do not reach clear plateau. Results of provided investigation support hypothesis that several small sized soil cores are more effective to evaluate faunal diversity of studied area.



Effects of *Aculus schlechtendali* (Acari: Eriophyoidea) population densities on Golden Delicious apple production

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Field trials were carried out in order to evaluate the seasonal abundance and impact on yields of the Apple Rust Mite (ARM) *Aculus schlechtendali* (Acari: Eriophyoidea) in an experimental fruit orchard located in northern Italy (Trentino region). The effects of ARM densities on yield and market quality parameters were assessed on Golden Delicious apple fruits. Fruit size, fruit weight, round colour hue, presence of russet as well as inside quality, i.e. soluble solids, acidity and Perlum index, were evaluated over two seasons considering different population levels of ARM that were determined by differential pesticide treatments. Effects of rust mites on return bloom and yield efficiency were also evaluated. Moderate to high rust mite densities affected fruits size, fruit weight, and round colour hue of Golden Delicious fruits. Rust mite seasonal abundance showed a peak in mid-summer. Relationships between rust mites and predatory mites, if present, were weak. In contrast, eriophyoid populations did not affect russet on fruits, return bloom and yield efficiency. In laboratory, the potential for population increase and spreading was assessed on detached Golden Delicious apple leaves, by considering different initial infestation rates, at three different constant temperatures. Laboratory tests evidenced a potential for high population increase and fast colonization all over different areas of apple leaf surface: depending on the starting density of *A. schlechtendali* individuals, the population doubled in 3-6 days; in 3-8 days, tens of eriophyoids could colonize more than two thirds of available leaf area.

Field Ecology and Population Dynamics

The tritrophic relationships among tomato varieties, tomato rust mite and its predators

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Trichome-mediated defense in tomato cultivated and wild tomato varieties has been extensively studied against some phytophagous mite species for several decades. As a result of previous studies that the mechanism can be negatively affected to phytophagous mites as well as their predators. To better explain the tritrophic relationship on tomato, the interactions between the population densities of *Aculops lycopersici* (Masse) (Acari: Eriophyidae) and its predators on different tomato varieties, namely Dora, Etna, Grande, H2274, Jana and M1103, and the trichome densities of these varieties were investigated in both a climatic room and an organic tomato field during 2014-2015. Under both controlled and field conditions, the population density of *A. lycopersici* was significantly high in the stake tomato varieties, Jana and Etna, compared with other tomato varieties. When the tomato rust mite's population density reached highest during mid August and mid September in the tomato field, the population densities of the common predator mite, *Tydeus kochi* Oudemans (Tydeidae), occurred similar population pattern. But, the predator mite density was significantly low in these tomato varieties. As a remarkable result, the densities of glandular trichome were found significantly higher in the varieties than other varieties. In contrast, significantly fewer glandular trichome was found in the indeterminate tomato varieties, Grande and H2274, which have lesser tomato rust mite and more the predator tydeid densities. These results of the present study supported the hypothesis is to claim that trichomes are excellent shelter for tomato rust mite and obstacle for its predator mites. On the other hand, the population density of insect and mite predators did not affect with trichome density

or tomato variety, but their population densities were observed very low in all varieties. In the current presentation, the relationships between tomato rust mite and its predators with six tomato varieties were discussed in detailed.

Seasonal densities of storage mites in wheat flour mills in Samsun Province, Turkey

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Storage mites are one of the main pest groups affecting both the quality and quantity of stored products. Many of them are also found indoors, causing diseases such as allergic asthma, rhinitis, dermatitis, urticaria and angioedema. The temperate climate and high humidity of Turkey's Black Sea region provide ideal conditions for these mites. The aim of this study was to determine the seasonal densities of harmful and beneficial mite species in wheat flour mills in Samsun Province, Turkey. During the surveys in the four seasons between 2013 and 2014, a total of 92 samples were collected from different areas of 23 flour mills. One hundred gram subsamples were taken and the mites were collected with the Berlese funnel extraction method, identified and counted. Eighty percent of the samples were infested by mites and a total of 22 species belonging to 13 families were collected. *Gohieria fusca* (Oudemans) and *Acarus siro* L. were the most abundant species, followed by *A. farris* (Oudemans) and *Dermatophagoides farinae* Hughes. Their population densities were highest in spring and summer, except for *D. farinae* which had a high population density only in summer. Only one individual of each of *Acaropsis sollers* Rohdendorf, *Blattisocius mali* (Oudemans), *Trichouropoda elegans* (Kramer) and *Zygoribatula* sp., was collected.

Oviposition, ontogeny and population growth of *Trichouropoda ovalis* (C.L. Koch, 1839) (Acari: Mesostigmata: Uropodina: Trematuridae) under laboratory conditions

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The biology of uropodine mites is still poorly known. So far, less than 1% of described species were more intensively studied regarding their life history. In this work, we provide description of the oviposition behaviour, analysis of selected morphometric changes during ontogeny as well as population growth of *Trichouropoda ovalis* (C.L. Koch, 1839). All observations were conducted at 21°C under laboratory conditions. Oviposition behaviour was studied with the use of Internet Protocol video recording, while ontogeny and population growth were studied using single-specimen as well as mass-rearing cages respectively.

Effects of habitat type on oribatid mite (Acari: Oribatida) communities structure in Southern Carpathians, Romania

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In our study we investigate the oribatid mite community structure and its relations with habitat type in sub-alpine screes and mountain forests from Piatra Craiului National Park, Southern Carpathians, Romania. Our survey was carried in 23 epigeal (scree and forest) and 80 hypogean assemblages (Mesovoid Shallow Substratum) from five habitat types: covered scree (CVS), nude scree (NDS), mobile scree (MBS), semimobile scree (SMS) and stabi-



lized scree (STS). The mites were sampled during two years (2008 – 2009) using pitfall traps and drillings. 1752 oribatid mites belonging to 98 species and three families were identified. Community composition and community structure models and analyses were applied and correspondence with habitat types, environmental parameters (temperature and humidity), months and altitude were made. The study provides new data regarding the ecological importance of scree habitats for oribatid mites communities and their implication for conservation.

Oribatid mites of conventional and organic vineyards in Valencian Community, Spain

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The study compared the oribatid mite communities of conventional and organic vineyards in El Poble Nou de Benitatxell, located in the Valencian Community, Spain. The soil samples were collected in the autumn 2014 and the spring 2015 from four sites, treated as the replicates, each including organic and conventional vineyards and a natural habitat (control). Two parallel samples were collected from three habitats in each vineyard (border, zone between vine rows, zone between vines) and from natural habitat, making the total of 128 samples. In total 3,225 oribatid mites were obtained (2,452 in the autumn and 773 in the spring), represented by 67 species. The species diversity of Oribatida was higher in the autumn than in the spring, while their abundance followed this pattern only in the vineyards, but not in the natural habitat. The oribatid communities did not differ between the conventional and organic vineyards, but differed among three studied habitats. The highest abundance and species number of Oribatida was found in the natural habitat (average density 5,900 individuals per 1 m² and number of species 20), followed by zone between vines (4,400 individuals per 1 m², 15 species), border (2,800 individuals per 1 m², 14 species) and was lowest in zone between vine rows (400 individuals per 1 m², 6 species). In vineyards *Oribatula excavata* Berlese dominated (D = 25), followed by *Minunthozetes semirufus* (C.L. Koch) and *Passalozetes africanus* Grandjean (D = 18 and 14, respectively), while in the natural habitat these species were very few. In the natural habitat most abundant was *Oppiella subpectinata* (Oudemans) (D = 28), followed by *Eremulus flagellifer* Berlese (D = 20), that in contrast were few in the vineyards. *Podoribates longipes* (Berlese) and *Steganacarus boulfekhari* Niedbala are reported from Spain for the first time.

Effector proteins of spider mites improve their performance by plant defense manipulation

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Herbivores have to deal with plant defenses which impair their digestion and performance. We found that most genotypes of *Tetranychus urticae* induce distinct plant defense responses in tomato while *T. evansi* suppresses these same processes to its own benefit. We hypothesized that mite salivary proteins secreted into the plant during feeding are responsible for this plant defense manipulation. These proteins are called effectors. Using bioinformatics we selected a group of effector-like proteins that were further analyzed in terms of (1) mite stage-specific expression and (2) localization of expression via *in situ* hybridizations. We could show that these proteins suppress salicylate responses, and possibly also those related to jasmonate, upon transient expression in *Nicotiana benthamiana* while the fitness of mites feeding from these leaves increased. This suggests that the secretion of these proteins is beneficial for spider mites by manipulating plant defenses.

Drought Stress in Tomato Plants increases the performance of the tomato russet mite, *Aculops lycopersici*

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Climate change is expected to bring longer periods of drought, especially in the Mediterranean area. For summer crops like tomato it may therefore be necessary to develop deficit irrigation strategies. Tomato is one of the most important horticultural crops worldwide and it is therefore important to know to which extent key tomato pests like the Tomato Russet Mite (TRM), *Aculops lycopersici* (Masse) will be affected by water deficit. This study aims to assess the extent of susceptibility of water stressed and normal tomatoes to TRM and to unveil some of the mechanism that underlies these observations. We tested, under laboratory conditions, if moderately drought-stressed tomato plants (simulating deficit irrigation) affect TRM population growth differently than non-stressed tomatoes. We observed that the TRM population grows significantly faster and causes more damage on moderately stressed plants. Subsequently we analysed to which extent TRM, drought and the combination affected the levels of tomato nutritional compounds (aminoacids, sugars, protein), phytohormones (ABA, SA, JA) and defences (anti-digestive proteins, volatiles). Our results suggest that a combination of changes in plant nutritional value and chemical defenses in drought-stressed tomato plants may cause the increase mite performance. The implications of these findings for TRM risk will be discussed.

Effects of landscape environment and pollen spilled on the density and diversity of predatory mites (Acari: Mesostigmata, Phytoseiidae) in vineyards of South of France

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Phytoseiidae, generalist predators, are known to “naturally” occur in vineyards. Their persistence in crops under prey scarcity suggest that population density is linked to the availability of alternative food resources. Landscape complexity might influence Phytoseiidae diversity and density (i) through dispersal of these predators from neighboring vegetation to vineyards and (ii) through a pollen reservoir as an alternative food resource deposited on grape leaves. This study aims to assess the effect of landscape complexity on Phytoseiidae in vineyards. Densities were monitored during three years in 18 experimental sites in South of France; landscape structure around each site was analyzed at different spatial scales (100, 250, 500, 750, 1000 meters). Phytoseiidae, prey and pollen densities on vine leaves were also assessed in two experimental plots during two years (2014 and 2015) from May to September. *Kampimodromus aberrans* was dominant in all experimental plots. Its densities were very high (18.4 adults/leaf in June) even when prey densities were low. Landscape characteristics affect *K. aberrans* densities. However, correlations between numbers of *K. aberrans* and landscape complexity varied with time and buffer size. Correlations were mainly observed in 2013. These correlations were globally negative, the highest being found for the closer buffer (0-100 meters). Pollen availability had a positive effect on density of *K. aberrans* for both adults and immature stages. However this effect was different according to the period. Some trends on two blots showed that no correlation between landscape complexity and pollen quantity was observed, however additional experiments should be carried out. Because diversity of vineyard landscape management affects population dynamics of *K. aberrans*, conservation and management of the semi-natural habitats at different scales seems to be a critical issue for ensuring biological control of phytophagous mites and thrips. Clearly other studies should be performed for better testing all these interactions.



Thermal sensitivity of *Amblydromalus limonicus* regarding its establishment potential in Austria under climate warming

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Most introductions of alien species do not result in invasions, which are mainly attributed to the high abiotic resistance of native ecosystems. The use of alien biocontrol agents and climate warming, however, may create ideal thermal conditions to overcome the abiotic resistance of native ecosystems resulting in the establishment and spread of non-native species. The alien predatory mite *Amblydromalus limonicus*, which can be legally used in Austria as greenhouse biocontrol agent against thrips since 2015, might be such a candidate. We compared three populations for their potential to overcome the abiotic resistance of native ecosystems: KO = population from the commercial producer Koppert, SP = alien population established in Spain since 2011, NZ = native population collected 2014 in Auckland, New Zealand. We examined the thermal sensitivity of *A. limonicus* regarding survival, juvenile development and oviposition within a temperature range from 10 to 35 °C, and evaluated their ability to enter diapause. Our results indicate that population increase of *A. limonicus* is possible within a temperature range of 10 to 30 °C with a thermal optimum around 25 °C, characterizing them as heat-sensitive, but relatively cold-tolerant without diapausing ability. Population differences in cold tolerance of *A. limonicus* were negligible. SP females, however, produced more eggs at 25 and 30 °C than KO and NZ females. Thus, we concluded that the SP population has the best options to invade Austrian predatory mite communities because of its higher reproductive potential at high temperatures compared to the other populations. The lack of diapause ability likely prevents the permanent establishment of *A. limonicus* in Austria despite of climate warming but temporary perennial establishment in years with mild winters might be possible.

Predator-prey interactions among mites in an open environment I: learned within-patch oviposition site shift promotes predator patch-leaving

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Dispersal is an important life history event that affects fitness of animals. However, because rearing animals in a close environment inevitably deprives them of dispersal opportunities, it should be noted that we may unintentionally observe unnatural behaviors of experimental animals which would have dispersed elsewhere in an open environment. Spider mites in the genus *Tetranychus* construct three-dimensional protective webs on leaf surfaces and usually oviposit under the webs, but they shift oviposition sites onto the webs in response to predatory mites that intrude into the webs. Although conventional observations in close environments reported that the eggs deposited on webs are less frequently predated than those on leaf surfaces, all eggs would be ultimately consumed in such environments without predator dispersal; egg survival should be rather examined with regard to predator patch-leaving decision in open environments. By using setups where predators could disperse from the prey patch, we tested whether the eggs deposited on webs are left by dispersing predatory mites, and whether previously experienced predation threats affect oviposition site selection of spider mites. Adult females of the spider mite *Tetranychus kanzawai* that had previously experienced its native predatory mite *Neoseiulus womersleyi* shifted oviposition sites onto webs even in predator-free patches. Predatory mites preferentially foraged spider mite eggs on leaf surfaces and left the prey patch earlier when higher proportion of eggs were deposited on webs. From these results, we conclude that spider mites protect offspring from future predation by learned within-patch oviposition site shift based on previous predation threats.

Age-dependent male mating tactics in a spider mite from a life history perspective

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Males fight with rival males for access to females. However, some males display non-fighting tactics such as sneaking, satellite behavior and female mimicking. Resource holding potential (RHP) theory predicts that these non-fighting tactics are displayed by less competitive males who are more likely to lose the fight. Life-history theory, however, predicts that young males avoid fighting, regardless of their RHP, if it pays off to wait for future reproduction. Recently, we described a sneaking tactic in young males of the two-spotted spider mite, *Tetranychus urticae* Koch. Alternative male mating tactics in the mite are neither associated with genetic dimorphism nor with morphological differences such as body size and weapon size. Here, to test the life-history theory, we investigated if young sneaker males survive longer than young fighter males after a bout of mild or strong competition with old fighter males. To test the RHP theory, we also investigated if old males have a more protective outer skin than young males by measuring cuticle hardness and elasticity using nanoindentation. We found that young sneaker males survived longer than young fighter males after mild male competition. Yet, hardness and elasticity of the skin did not vary with male age. Given that earlier work also could not detect any morphometric differences between fighter and sneaker males, we conclude that age-dependent male mating tactics in the mite cannot be explained by the RHP theory, but can be explained by the life-history theory.

Proximate variability of early learning in foraging predatory mites

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Learning, changed behavior following experience, is ubiquitous in animals, from protozoans to primates. In many animals, the effects produced by early life experiences are more persistent and profound than those made later in life. However, the expression of early learning may largely vary, both constitutively and proximally, among individuals and populations. Constitutive variability is due to adaptation, proximate variability depends on the immediate behavioral and ecological contexts. Here, we demonstrate cue-, diet- and attention-related causes of proximate variability in early learning by two generalist predatory mite species, *Neoseiulus californicus* and *Amblyseius swirskii*, in foraging contexts. The adult females of both species improve foraging on thrips after having experienced thrips prey early in life. We scrutinized which prey cues are used by the predators for learning, compared the underlying learning mechanisms (associative vs. non-associative), investigated the influence of the maternal and immediate diets, and looked at trade-offs in bi-contextual learning (social vs. foraging context). *Neoseiulus californicus* was able to improve foraging on thrips following early experience with traces left by prey, physical contact with prey and feeding on prey. In both predators, *N. californicus* and *A. swirskii*, external prey cues paired with a feeding reward produced a stronger learning effect than mere contact with prey cues without reinforcement. Maternal pollen diet and pollen presence during the learning phase interfered with, and compromised, the expression of learning in *A. swirskii*. Similarly, the presence and learning of prey compromised familiarization among kin, i.e. learning each other's features, in *N. californicus*. These findings demonstrate highly advanced but fragile learning abilities of predatory mites and may pave the way for optimizing their use in biological control.



Compensatory growth following transient intraguild predation risk in predatory mites

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Compensatory or catch-up growth following growth impairment caused by transient environmental stress, due to adverse abiotic factors or food, is widespread in animals. Such growth strategies commonly balance retarded development and reduced growth. They depend on the type of stressor but are unknown for predation risk, a prime selective force shaping life history. Anti-predator behaviours by immature prey typically come at the cost of reduced growth rates with potential negative consequences on age and size at maturity. Here, we investigated the hypothesis that transient intraguild predation (IGP) risk induces compensatory or catch-up growth in the plant-inhabiting predatory mite *Phytoseiulus persimilis*. In the Mediterranean region, *P. persimilis* is a member of naturally occurring predatory mite guilds involving *Neoseiulus californicus* and *Amblyseius andersoni*, sharing the spider mite *Tetranychus urticae* as extraguild prey. The six-legged, little mobile and non-feeding larvae of *P. persimilis* are the most vulnerable IG prey individuals within this guild, with adult *A. andersoni* and *N. californicus* females being high and low risk IG predators, respectively. Immature *P. persimilis* were exposed in the larval stage to no, low or high IGP risk, and kept under benign conditions in the next developmental stage, the protonymph. High but not low IGP risk prolonged development of *P. persimilis* larvae, which was compensated in the protonymphal stage by increased foraging activity and accelerated development, resulting in optimal age and size at maturity. Our study provides the first experimental evidence that prey may balance developmental costs accruing from anti-predator behaviour by compensatory growth.

Predator-prey interactions among mites in an open environment II: further interactions between spider mite and predatory mite offspring

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Dispersal is an important life history event that affects fitness of animals. However, because rearing animals in a close environment inevitably deprives them of dispersal opportunities, it should be noted that we may unintentionally observe unnatural behaviors of experimental animals which would have dispersed elsewhere in an open environment. Spider mites live together in protective webs on leaf surfaces. Adult females of *Tetranychus kanzawai* (TK) disperse from these webs when a predatory mite *Neoseiulus womersleyi* (NW) intrudes into the webs. NW adult females also disperse from the webs, leaving prey for their offspring in the webs. By using setups to determine within- and between-patch dispersals of both mites, we examined prey-predator interactions of offspring mites left in the webs. Although both TK larvae and deutonymphs recognized NW larvae in the same webs, TK larvae never dispersed from the webs. On the other hand, TK deutonymphs dispersed within patches in response to high NW larvae density but did not disperse between patches as do TK adult females. TK deutonymphs dispersed from the webs in response to artificially punctured conspecific eggs but did not in response to encounter with NW offspring. Developmental time of TK offspring in predators' absence did not differ with respect to the presence of natal webs, while most larvae and deutonymphs without natal webs were preyed upon by potential predators (*Euseius sojaensis*, for example) that cannot penetrate the webs. These results suggest that TK larvae and deutonymphs stick to natal webs to gain protection by the webs, not to save costs of building webs.

Genetics and Evolutionary Acarology

Beating DNA out of mites

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Details of the methods for the DNA extraction of mites have become more important with an increased interest in whole genome sequencing using next generation sequencing techniques on one side and the advancement of molecular techniques in forensic acarology on the other side. Currently one of the most used methods for homogenisation of microarthropods is bead beating employing small grinding or cutting beads in a shaking micro-tube homogenizer (BeadBug Benchmark Scientific). A wide variety of bead materials were investigated (glass, garnet, zirconia, steel, and carbide). The influence of different bead sizes (0.1 – 3.0 mm), different densities of the bead material (2.5 – 14.9 g/cm³), and different shapes of the beads (round balls or sharp-edged particles) on the quantity and quality of DNA extracted from mites was systematically investigated using the Qiagen DNeasy Blood & Tissue kit. The comparison was performed with four mite species: *Tyrolichus casei* (Acaridae) as a future model lab or food mite, *Tyrophagus putrescentiae* (Acaridae) as a model stored-product mite, *Dermatophagoides farinae* (Pyroglyphidae) as a model house dust mite, and *Archezogetes longisetosus* (Trhypochthoniidae) as a model soil mite.

Genome annotation of the flat mite *Brevipalpus yothersi* Baker (Tenuipalpidae)

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The flat mite *Brevipalpus yothersi* Baker, previously erroneously named as *Brevipalpus phoenicis* (Geijskes), was recently resurrected and redescribed into the *B. phoenicis* sensu stricto group. This species is one of the most important pests among the flat mites (Tenuipalpidae); these mites are highly polyphagous and their major importance is due to the transmission of numerous plant viruses- the *Brevipalpus* transmitted virus, BTV's- which can seriously affect crops such as citrus, coffee, passion fruit and ornamental plants. Among them, the *Citrus leprosis virus* (CiLV) has been considered a key virus for the citrus production in some countries of South and Central America, as well as of the Caribbean. Due of their importance as vectors several studies have been conducted in order to understand the virus-vector interactions, also considering the diversity of species that may be involved. Advances in resources for genomic analyses are essential to the functional biology knowledge, however genomic data about plant mites remains limited. Here we present some features from the initial genomic analyses of assembly of the *B. yothersi* genome. The assembly data was performed from 454 reads and Illumina reads (paired-end and mate-paired). To successful annotation and determine the assembly quality different tools were used- Newbler, CLC genomics, and SSPACE. These analysis resulted in 849 scaffolds and the cumulative size is 72.286 Mb. Comparisons using the spider mite *Tetranychus urticae* Koch genome data showed that 6.4% of the total size of *B. yothersi* scaffolds is homologous to the known repeats from the spider mite library. Although the coding sequence of the flat mite can be considered significantly different from that of *T. urticae* (<80% nucleotide identify), the predicted proteins show good alignment coverage with spider mite genes (~2000). Next steps include collecting more gene models and RNAseq data to further train the splice to gene prediction programs. A relative good quality of *B. yothersi* genome assembly was obtained and the gene prediction quality was improved using evidence from spider mite alignments. The annotated *B. yothersi* genome constitutes a valuable genomic resources to investigate the biology and the rare thelytoky system of the complex mite-virus-plant interaction. Financial Support: CNPq, Fapesp, Embrapa.



Contrasting patterns of diversity and genetic structure in feather mite communities of *Calonectris* shearwaters

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For obligate parasites with limited dispersal ability, the spatial distribution and life history traits of their hosts can be essential factors determining parasite population structure and patterns of diversification. Studies in avian ectoparasites with no independent dispersal abilities have revealed surprisingly low degrees of host specificity and high dispersal rates among distant host populations. Here, we compared morphological and genetic diversity of feather mites inhabiting three sibling species of *Calonectris* shearwaters to test whether transmission of feather mites occurs during transient interactions among host individuals. Knowing that feather mites are among the most diverse and abundant avian ectosymbionts and evolve in close association with their hosts, we expected to find highly divergent communities on different host species and strong population structure among distinct geographic locations. Our findings only partially support these predictions. The three shearwater species were found to harbour a rich mite fauna composed of nine morphologically distinguishable species, of which five were shared by the three hosts. Molecular diversity at two mitochondrial genes correlated well with morphological descriptions, but revealed the presence of four additional cryptic lineages. Furthermore, population genetic analyses showed variable patterns of structure for each mite species that correlated with mite microhabitat use. Two species inhabiting flight feathers, *Microspalax brevipes* and *Zachvatkinia ovata*, exhibited low genetic diversity and were genetically unstructured among hosts and localities. In contrast, *Brephosceles puffini* and *Plicatilloptes sp.1*, which live in more protected feather microhabitats, showed higher genetic diversity and an important degree of among population differentiation. Our results therefore support the hypothesis that brief inter- and intra-specific interactions among hosts are of key importance for the exchange and dissemination of avian ectofauna, but that the importance of this mechanism and its implications for the evolution of parasite diversity is conditioned by species-specific life history traits.

Preliminary data on the relationship between *Colomerus vitis* (Acari: Eriophyidae) and Grapevine Pinot gris virus (GPGV) and population mite composition in Italy

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GPGV (Grapevine Pinot gris virus) is a new trichovirus associated to mottling and deformation of grapevine leaves (GLMD). The pathogen is spreading in the European vineyards and all over the World. Considering the phylogenetical similarity of this virus with other trichoviruses transmitted by eriophyid mites, GPGV was candidate for the group of mite-borne viruses, in particular for the transmission by *Colomerus vitis* (Pagenstecher). *Colomerus vitis* is one of the two main eriophyid mite pests of the grapevine. According to mite behaviour and induced injuries, three strains are usually distinguished in literature: erineum, bud and leaf curl strains. All strains cannot be separated from their morphology and can overwinter in grapevine buds. Recently, a genetic difference between erineum and bud strains was reported. Aim of this research was to investigate *C. vitis* as a potential GPGV vector and to study the genetic and morphological characterization of *C. vitis* populations collected from Northern Italy, where GPGV is spreading. The results of acquisition and transmission trials shows that *C. vitis* can be considered a GPGV low efficient vector. The populations of northern-Italy *C. vitis* can be considered genetically similar but with morphological differences when it is collected on different plant parts (Erineal leaves/Buds), different grapes varieties and different seasons.

Effectiveness of COI as a barcode for oribatid mites

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Oribatid mites represent the most diverse and numerically dominant arthropods in soils and have an important role in organic matter decomposition. Traditional morphological approaches to the identification of species are difficult and time consuming. DNA barcoding techniques could greatly facilitate rapid characterisation of complex mite communities, but so far there has been little work to promote this approach. Here, we examine the effectiveness of the COI gene as a barcode for oribatid mites. Using published data of COI from 1604 individuals representing 64 species, this study examined intra- and interspecific sequence divergence to estimate whether species boundaries could be defined and if barcode gaps were commonly present. Mean intraspecific divergence was 0.03 and mean interspecific divergence was 0.30. Two different approaches have been used to detect the presence of a barcode gap. The first one compared the maximum intraspecific distances with the minimum interspecific distances, which resulted in 84.3% of the species presenting a gap. With the second approach which compared 10x mean intraspecific variation, 74% of the species had a barcode gap. We tested four thresholds for species delimitation: 3%; a taxon-specific value; a threshold based on the 10x rule and a new approach using thresholds based on networks modules. A 25% threshold, that is the taxon-specific value, discriminated the highest percentage of species but according to the network modules method this value would cluster together also not conspecific individuals, identifying a 16% threshold as the best one for oribatid mites according to our data. We conclude that due to the high intraspecific variation of some oribatid species observed using COI as a barcode, it is difficult to establish a threshold able to clearly delimit species. Furthermore we finally indicate the need for future morphological and phylogenetic studies for some mite species and the use of additional genes.

Biological Control and Integrated Pest Management

Effects of plant water stress on lavender and Greek sage essential oil quality and biocidal properties against *Tetranychus urticae*

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Pesticides based on plant-essential oils are a relatively new class of products that show great potential for commercial use because of their low environmental impact. A small number of essential oil-based products have been commercialized already, but there is still great potential for product development, as we gain information on the activity of oils from different plants. We investigated the toxicity to *Tetranychus urticae* of essential oils from lavender (*Lavandula angustifolia*) and Greek sage (*Salvia fructicosa*). Lavender and sage plants were grown in a greenhouse under normal irrigation, medium and intense water stress. Plants grown under water stress grew less and exhibited different chemical composition than plants under regular irrigation. Water stressed plants produced a higher yield of essential oils with higher concentrations of antioxidants (phenolic) substances. The LC₅₀ of lavender essential oil vapors from control plants was estimated at 4.93 µl/l, while that of sage at 3.77 µl/l. Essential oil vapors from lavender plants under medium water stress caused significantly higher mortality to *T. urticae* females than essential oils from plants under regular irrigation. Water stress did not affect the toxicity of sage essential oils. We conclude that plant essential oils may provide an alternative to chemical acaricides for the control of *T. urticae*, and that plant water stress increases the effectiveness of certain essential oils against arthropod pests.



Characterization of predatory mites assemblages in laying hens farms and potential for biological control

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The Poultry Red Mite (PRM), *Dermanyssus gallinae*, is a bloodsucking nidicolous ectoparasite commonly parasitizing birds. It is of economic importance as a worldwide pest in the poultry industry. PRM spends most of its life off host, usually hidden in cracks, crevices and other narrow places provided in huge number by the farm structure in the vicinity of birds. This is one of the reasons why conventional pesticide spraying is often unsuccessful and the currently authorized molecules do not suffice to eradicate poultry red mites. Therefore, alternative control solutions already exist or are in the process of being developed such as food additive, plant-derived products or natural enemies, with more or less efficiency. One promising solution may be to promote ecological processes already in action in farm buildings (conservation biological control) as a complement of existing means. Yet, different predatory mite species develop in solid substrates present in laying hen farm such as manure, dry droppings and dust and the arthropods biodiversity seems to vary from one farm to another one. Here we provide the design and first results of a recently started project aimed at identifying mite assemblages (and possibly others associated organisms) with a potential suppressor effect on the poultry red mite. We first started to characterize the mite communities present in free-range farms with different PRM infestation histories using both morphological and molecular tools. We present our first results in terms of inventories of mite morphospecies and molecular characterization of mite communities, and discuss about first insights on inter-farm variation.

Testing a new predator installation method in protected cucumber crop in Spain: Predafix^â

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Installing predatory mites prior to pest arrival is a key matter in many protected crops and is often a hurdle to the development of a biological control strategy. In cucumber protected crops, most of the producers do not widely use biological control because of the expensive cost of replacing sachets, which furthermore does not always guarantee an optimal pest control. Biotop has been testing a new preventive method to better install predatory mites on protected crops, prior to the arrival of the pests. It consists in spraying a mix of an alternative food (dust mites' eggs) and a gel that allows this alternative food to be available and turgescient on the plant for a longer time. A trial has been conducted in Vicar (Almeria, Spain) on protected cucumber crops by Anadiag Ibérica from October 8th until November 12th 2015. Two modalities were tested: the first was a classical biological strategy with only *Amblyseius swirskii* sachets releases, while in the second Predafix^â sprayings were added to this first strategy. Counting of *A. swirskii* and *Bemisia tabaci* was done on 25 leaves per plot, 5 plots per modality every week during 5 weeks. Even if the mean number of *A. swirskii* was not always significantly higher in the modality with Predafix^â compared to the classical sachets strategy, mean number of *B. tabaci* was significantly reduced at the end of the experiment (Week 5 after release: 4.6 and 9.5 *B. tabaci* larvae /leaf, respectively). In both modalities *A. swirskii* was quickly observed on more than 75 % of the plants, and up to 100 % with Predafix^â in week 5 after release. No phytotoxicity has been observed during the trial. This trial shown that Predafix^â significantly improves the classical sachets methods used to control *B. tabaci* in protected cucumber crops in Almeria, Spain. More field data is now needed to adapt this installation method to different crops, climates, and field uses.

Use of predatory mites in commercial biocontrol: current status and future prospects

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Predatory mites play the leading role in commercial augmentative biological control. They are mainly used in protected vegetable and ornamental cultivation systems to control phytophagous mites, thrips and whiteflies. Use in open-field systems and in animal husbandry is still limited. Phytoseiidae species are by far the most important group of commercially available mite biocontrol agents with about 20 species offered worldwide. Out of these, *Amblyseius swirskii*, *Phytoseiulus persimilis*, *Neoseiulus cucumeris* and *Neoseiulus californicus* are the most important ones, covering together about two thirds of the entire arthropod biocontrol agent market. The widespread use of these leaf-inhabiting predatory mites has stimulated research in their biology and we now have substantial knowledge in, for instance, the interaction between different predatory mite species that helps to improve biocontrol programmes. Soil predatory mites, for example *Stratiolaelaps scimitus* (Laelapidae) or *Macrocheles robustulus* (Macrochelidae) for the control of sciarid fly larvae and thrips pupae are much less frequently used and also much less researched. This makes further development of biocontrol strategies using these mites more difficult. Currently, there is no reliable method to quantify the abundance of these mites in soil samples. In studies at our laboratory, the frequently used Berlese funnels gave very variable results. We observed that soil predatory mites can even multiply during the extraction process. In addition to the control of plant pests, predatory mites can also be used to control parasites of animals like the chicken red mite, *Dermanyssus gallinae*. Good results have been obtained with a combination of the predatory mites *Androlaelaps casalis* (Laelapidae) and *Cheyletus eruditus* (Cheyletidae) in laying hen stables. This presentation provides an overview on the current status of commercial biological control using predatory mites and identifies research needs to make the currently available mite biocontrol agents even more successful and extend biological control with mites to other areas.

Biological control of spider mites in North-Italian vineyards using pesticide resistant predatory mites

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The success of phytoseiid mite releases to control spider mites [*Eotetranychus carpini* (Oudemans) and *Panonychus ulmi* (Koch)] on grapevine can be influenced by the pesticide use and the competition with local predatory mites. In field experiments we evaluated the effect of the release of *Kampimodromus aberrans* (Oudemans) and *Typhlodromus pyri* Scheuten strains showing field resistance to organophosphates and dithiocarbamates. Predatory mites were released in vineyards infested by spider mites despite the occurrence of *Amblyseius andersoni* (Chant) and/or *Phytoseius finitimus* Ribaga. Single or mixed releases were planned. Spider mite populations were not effectively controlled by local predatory mites while successful control was achieved by released species. The effects of releases were higher in the second experimental year. In most cases *A. andersoni* densities were reduced by *T. pyri* and *K. aberrans* releases. *Ph. finitimus* suffered less than *A. andersoni* from intraguild predation. Among released species, the effect of the presence of a competitor was higher on *T. pyri* than on *K. aberrans*. Results suggest that the outcome of intraguild predation is prey-mediated. The equilibrium level between *K. aberrans* and *T. pyri* may depend on which spider mites species is the shared prey. The implications in management of spider mites on grapevine are discussed.

Efficacy of some mushroom extracts against *Tetranychus urticae* Koch

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The two spotted spider mite, *Tetranychus urticae*, is an economically damaging polyphagous mite worldwide that feeds on more than 150 species of host plants, including most deciduous fruit trees and vegetables. Using pesticides extensively has led to the development of pesticide resistance, environmental pollution, toxicity to non-target organisms and risks for human health. The aim of this laboratory study was to determine the acaricidal, ovicidal and repellent effects of some mushroom extracts against *T. urticae*. The experiment was conducted in a completely randomized plot design under laboratory conditions at 23 °C and 46% R.H. with *Craterellus cornucopioides*, *Ganoderma lucidum*, *Lactarius deterrimus*, *Lentinula edodes*, *Marasmius oreades* and *Pleurotus eryngii*, Neemazal (0.5% and 2%), ethanol and distilled water as the control. Experiments were replicated ten times, with ten mites in each replicate. Spray applications were applied to newly emerged, copulated females. Observations were made daily for six days for the adults and for twelve days for the larvae. One way ANOVA and Duncan's multiple range test were used for statistical analyses. The efficacy of each treatment was determined with the Abbott formula. They were all effective against *T. urticae*, with *P. eryngii* (87%), *M. oreades* (86%), *L. edodes* and *C. cornucopioides* (73%) having the highest acaricidal effect. These mushroom extracts may have the potential to control *T. urticae*.

Provisioning of multiple resource supplements to enhance the populations of predatory mites

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Plants and entomophagous arthropods can be linked through various protective mutualisms. For example, in many plants extra-floral nectar could serve as food rewards to attract and retain entomophagous arthropods supporting defensive mutualists. In addition, plants may possess domatia, which are structures that serve as shelter and/or oviposition sites. Ant domatia have been well described, but acarodomatia are far more common, consisting of often inconspicuous hairy tufts on the underside of the leaves used by predatory mites. In nature, these indirect defensive traits often occur in combination. However, we know little about how these traits interact. Here, we tested the impact of provisioning fibers (simulating acarodomatia), in combination with pollen and sugars (food rewards) on the oviposition and population development of phytoseiid mites in citrus. The highest oviposition and population densities of phytoseiid mites were recorded in the treatment where the three components were offered in combination. Moreover, the combined impact of the three components was higher than the sum of each component provided individually, providing evidence for a three-way synergy between the fibers the pollen and sugars. These results demonstrate that the combination of multiple indirect defensive traits strongly enhances the impact of predatory mites, thus offering new tools to optimize their use in conservation or inundative biological control programs.

Pollen quality effects on the response of phytoseiid predators against thrips

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During periods of prey scarcity, the provisioning of pollen as an alternative food source in greenhouse crops may support the early establishment and population build-up of generalist phytoseiid predators, thus enhancing the efficiency of biological control. However, in the presence of prey, pollen availability may exert an antagonistic effect to biological control, through either a substantial reduction in predator's functional response or a direct positive (dietary) effect on the fitness components of herbivores prey, such as in the case of the thrips *Frankliniella occidentalis*. Contrary to these negative effects, pollen consumption in a mixed diet may have a positive effect on the numerical response and the population dynamics of a generalist predator, thus synergizing biological control. We assume that the overall effect of pollen provisioning as an alternative food source on the predator-prey

population dynamics, could be directly related to the nutritional quality of the pollen itself as well as the dietary requirements of the predators involved. In the present study, we assessed the effect of the pollen from three plants (*cattail*, corn and pine) on the predation efficiency and numerical response of three phytoseiid predators (*Amblydromalus limonicus*, *Amblyseius montdorensis* and *A. swirskii*) against *F. occidentalis* in lab and greenhouse experiments. We show that pollen substantially decreased the predation rate of all predators, irrespectively of the pollen species tested. This reduction was significantly higher for *cattail* and corn pollen, which were both proven of higher nutritional quality compared to pine pollen. Importantly, despite this short-term negative effect, the provision of *cattail* pollen (shown as the highest quality pollen) had a clear positive effect on population increase of all predator species and this was also reflected in thrips control in the greenhouse.

A new physical control of spider mite featuring UVB — Strawberry and carnation

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Based on the recent knowledge on lethal effects of ultraviolet-B (UVB) radiation on spider mites, we tested the control effect of *Tetranychus urticae* by combined use of overhead UVB lamps and light reflection sheets (LRSs) on strawberry plants (50 and 35 or 30 cm intervals between lows and plants, respectively, and UVB irradiation at 2.16 kJ/m²/d) in a greenhouse from December to May (2012–2013 and 2013–2014). *T. urticae* population was suppressed throughout experimental periods at UVB+LRSs with no acaricide application. Negative correlations between mite densities and UVB irradiances on lower leaf surfaces upheld the control effects by UVB. Subsequently, to apply this method for farmers, we examined under more practical condition in 2014–2015 (rows × plants = 40 × 30 cm, UVB irradiance = 1.62 kJ/m²/d). We introduced *T. urticae*, and *Tetranychus kanzawai* occurred naturally. The peak densities were 275.6 (19 April) and 63.0 ♀♀ (30 May) per plant in control (sprayed with acaricide once) and UVB+LRSs (no acaricide application), respectively. Slight sunscald was caused on leaves but not on fruits by UVB irradiation. As a result, harvest of strawberry was 10% larger in UVB+LRSs than control. To expand the application of this method into ornamental plants, we tested the control effects on *T. urticae* infesting potted carnation plants in glasshouse from December to February in 2015–2016. UVB irradiance at the 20 cm high (equivalent to the plant length at the beginning of experiment) was 1.4 kJ/m²/d. Control effects were notable; 67.6 and 2.5 ♀♀ per plant in control and UVB+LRSs, respectively, at day 63 after the introduction of mites. Slight leaf damage was again observed. Sunscald on leaves concerns the production of ornamental plants. Optimization with respect to the balance between mite control and damage on carnation is also worthwhile.

First assessment of biological features of *Typhlodromus (Anthoseius) recki* (Mesostigmata: Phytoseiidae) feeding on *Tetranychus urticae* (Trombidiformes: Tetranychidae)

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Family Phytoseiidae is a well-known predatory mite group. It currently contains more than 2,400 species. However, no more than 50 species are presently used in biological control worldwide. Many advances are thus expected for exploiting the remaining biodiversity and developing new efficient biological control agents. For this purpose, more studies should be carried out to assess the biological features of these species. The present study focuses on a species belonging to the sub-family Typhlodrominae and classed in the predator Type III category: *Typhlodromus (Anthoseius) recki*. This species is commonly found in uncultivated areas and sometimes in crops in Europe. However, no data on its biology are available. Five populations of this species collected in South of France have been considered. Their abilities to eat *Tetranychus urticae* as well as their fecundity were assessed in lab experiments. Differences between the five populations have been observed. The fecundity rates (number of eggs/ female/ day) ranges between 0.5 and 1.4. The number of eggs of *T. urticae* consumed per female and per day ranges between



8 and 18. When the amount of prey is important in first days of the experiment, predation rates higher than 40 eggs consumed per female per day have ever been observed. The number of prey consumed for some of the populations herein tested is quite similar to those reported for some predatory mite species used in biological control, such as *Neoseiulus californicus* and *Amblyseius swirskii*, for example. Such results emphasize the potential capacity of *T. (A.) recki* to regulate *T. urticae*. Furthermore, as *T. (A.) recki* is endemic of Europe, such results open new insights for using endemic biodiversity to limit side effects of biological control within international exchange rules. However, additional studies are clearly needed to determine optimal rearing conditions, prey ranges and predation behaviour in field conditions.

Citrus cultivars differentially affects predator species establishment and the outcome of intraguild competition between plant feeding and non-plant feeding phytoseiids

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Plant fluid uptake by predatory mites has been demonstrated with dyes, pesticides and isotopes. However, only recently has it been shown that phytoseiids, such as species belonging to the genera *Euseius* and *Iphiseius*, actually feed from the plant. Interestingly we found *Euseius* and *Iphiseius* species to be more effective citrus rust mite predators than the non-plant feeding species *Amblyseius swirskii*. As phytophagous pest mites are known to be affected by cultivar we hypothesized that plant feeding predatory mites would be more affected by cultivar than the non-plant feeding *A. swirskii*. Additionally we asked whether intraguild predation between *Euseius* species and the more aggressive *A. swirskii* could be affected by cultivar. Mite species were monitored on non-sprayed pomelo and Shamouti (an orange CV) trees in the field, provisioned with windborne pollen from flowering cover crops, following the sequential releases of *Euseius scutalis* and *E. stipulatus*. Under semi field conditions establishment of these two species was evaluated on pomelo and Shamouti seedlings, provisioned twice a week with pollen, naturally colonized with *A. swirskii*. In the field on pomelo the establishment of *E. stipulatus* was minimal whereas population levels of the naturally occurring *A. swirskii* were very high. In contrast in the Shamouti plot the populations of *E. stipulatus*, adjacent to the pollen source, were higher than those of *A. swirskii*. Establishment of *E. scutalis* in both plots was nil. In the seedling trial the levels of *A. swirskii* were substantially higher on the pomelo cultivar than on Shamouti, whereas the populations of *E. stipulatus* were not affected by cultivar. This result contradicts our hypothesis as it was the non-plant-feeding predator *A. swirskii* that was affected by cultivar, perhaps because *E. stipulatus* is a citrus adapted species, naturally occurring on many citrus cultivars in Europe and North Africa. With respect to our second research question, it appears that the cultivar does affect the degree of intraguild competition between *A. swirskii* and *E. stipulatus* and could explain why it was not possible to establish *E. stipulatus* on pomelo trees.

Chemical Control, Resistance and Toxicology

Jasmonate defenses operate against target and non-target mites

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When herbivores such as spider mites feed on plants, the host establishes a defense response. This induced response is coordinated by signaling molecules and characterized by the synthesis of secondary compounds (toxins), which decrease herbivore performance. A key signaling molecule is jasmonic acid (JA) and there are many examples of herbivores that are vulnerable to JA defenses including the spider mites *Tetranychus evansi* and *T. urticae*. Yet they are common pests on tomato and they were found to cope with JA defenses differently. While *T. evansi* is able to suppress JA defenses in tomato and thereby upholds its maximal performance, *T. urticae* induces these defenses and consequently displays intermediate performance. Here, we show that also natural enemies of spider mites are affected by JA defenses via their prey. One of these organisms is beneficial to tomato plants, the predatory mite *Phytoseiulus longipes*. We observed that spider-mite eggs produced on JA-defended plants were eaten less by *P. longipes* than eggs produced on JA-undefended plants. This suggests that the effect of JA defenses are transmitted to spider mite eggs and that *P. longipes* is sensitive to these defenses similar as its prey. A second organism affected by JA defenses via the eggs of spider mites is the omnivorous thrips *F. occidentalis*. Thrips is not only a pest on tomato but is also known to feed on spider mite eggs. Also here we observed that egg predation is negatively affected by the presence of JA defenses in the plants on which these eggs had been produced. We will discuss the ecological consequences of these results, since they indicate that a plant's JA-dependent defenses can antagonize natural enemies via the eggs of their prey indicating a trade-off between direct and indirect defenses.

Acute and lethal effects of some pesticides to the native population of *Amblyseius swirskii* (Acari: Phytoseiidae) collected from a commercial citrus orchard

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In spite of heavy applications of pesticides, *Amblyseius swirskii* Athias-Henriot (Acari: Phytoseiidae) is the most common species of the predatory mite family Phytoseiidae in commercial citrus orchards in Eastern Mediterranean region of Turkey. This species is also available in international markets for augmentative biological control of thrips and whiteflies in various greenhouse crops. In this study, acute and lethal effects of some pesticides commonly preferred in citrus production (abamectin, etoxazole, spirotetramat, spiromesifen and pyridaben) to the native population of *A. swirskii* collected from a commercial citrus orchard were determined for IPM programs. Under laboratory conditions, eggs, larvae and five days old ovipositing females were transferred to bean leaf-discs and sprayed with commercial formulations of the above given pesticides at maximum recommended dose for field application. Only abamectin and pyridaben significantly reduced egg production of the predatory mite. Furthermore, the recorded eggs and larval mortality reached 36 and 84% for abamectin, 28 and 87% for pyridaben, respectively. Adult mortalities were recorded as 21 and 96% for abamectin and pyridaben, respectively. Whereas mortality caused for the rest of three pesticides were recorded below 10% for eggs, larvae and adults of *A. swirskii*. According to results, etoxazole, spirotetramat and spiromesifen may be compatible with *A. swirskii* for IPM programs in citrus. In addition, further field and/or semi-field experiments are essential in order to clarify toxicity of abamectin and pyridaben to the predator, if their alternatives are not available.

Molecular diagnostics for detecting pyrethroid and abamectin resistance mutations in *Tetranychus urticae*

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We developed molecular diagnostic assays to facilitate resistance management of major agricultural pests including *Tetranychus urticae*, one of the most devastating pests of protected and open field crops worldwide. Abamectin and pyrethroid resistance mutations (the G314D and G326E abamectin resistance mutations in the



glutamate gated chloride channels, and the F1538I pyrethroid resistance mutation in the voltage gated sodium channel respectively) have been reported in *T. urticae*. We developed three TaqMan molecular diagnostic assays for reliably monitoring the presence of these mutations in *T. urticae* field populations. The molecular diagnostic tools were validated against known genotypes and subsequently used to monitor the frequency of the resistance mutations in eleven *T. urticae* populations from Greece and Cyprus, with variable history of avermectin and pyrethroids applications. The frequency of the F1538I pyrethroid resistance mutation largely varied among samples, with highest frequencies (75% - 97%) detected in four populations derived from protected and open field crops from Greece, low frequencies in two populations (2.5% - 11%) and complete absence in four populations. The frequency of the abamectin resistance mutations G314D and G326E also varied across populations (from 0 to 100%), showing fixation in two populations (more than 97.5% for G314D and 100% for G326E), originating from rose greenhouses from Greece, low frequencies in three populations (5% - 12.5%) and complete absence in six populations. The TaqMan diagnostics showed higher resolution in detecting specific alleles in low frequency, compared to massive quantitative sequencing approaches, and thus can be used, together with classical bioassays, to support evidence – based insecticide resistance management strategies. These results were deposited in the resistance database Galanthus, an ontology-based pesticide resistance database (Galanthus, <http://www.galanthos-prd.gr>), in order to facilitate monitoring of the dynamics of resistance alleles and resistance management.

Cross-resistance risk and molecular analysis of complex II inhibitors in the two-spotted spider mite *Tetranychus urticae*

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The highly polyphagous spider mite *Tetranychus urticae* causes problems worldwide and develops resistance to acaricides very rapidly. The release of acaricides with a new mode of action that breaks current resistance patterns is crucial to maintain agricultural production. Cyflumetofen and cyenopyrafen are both complex II inhibitors and have recently been introduced to control phytophagous mites. Different levels of cross-resistance to cyenopyrafen and cyflumetofen were uncovered in a collection of multi-resistant strains. Synergism tests revealed the importance of certain detoxification enzyme families in resistance. We then selected for cyenopyrafen and cyflumetofen resistance in the laboratory, and obtained highly resistant strains. The possibility of target-site resistance was assessed by sequencing all relevant subunits of complex II, but could not be detected. Genome-wide gene-expression patterns of the cyflumetofen and cyenopyrafen resistant strains were obtained and compared with a set of expression data of strains resistant to most currently used acaricides. The analysis revealed specific genes involved in detoxification, such as a P450 and a GST associated with resistance. The implications of our findings for insecticide resistance management strategies will be discussed.

Establishment of integrative resistance levels to provide practical management action in *Tetranychus urticae*

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Tetranychus urticae has been considered as a major pest in rose cultivation area in Korea. Both phenotypic and genotypic resistance detection systems were established based on the residual contact vial bioassay (RCV) and quantitative sequencing (QS), respectively, for the rapid monitoring of acaricide resistance status. In this study, we tried to integrate all available information associated with phenotypic and genotypic resistance traits, respectively) to provide practical management actions. The phenotypic and genotypic resistance levels were determined by employing the RCV and QS methods for 46 field populations, which were collected from rose, strawberry and

apple trees. Most populations exhibited multiple resistance patterns to various types of acaricides. Especially, the resistance levels in mites from rose cultivation area were higher than those from strawberry and apple cultivation areas, suggesting that frequent application of acaricides is a major driving force to develop multiple resistance in the field. The integrated phenotypic and genotypic resistance traits were determined by assigning a weight on each resistance value after categorization and by combining together. Each weight was multiplied and the values were re-categorized to assign the management rank after log transformation. The practical management action was empirically suggested by considering the resistance potential based on the integrated resistance allele frequencies and the control efficacy of various acaricides. Taken together, about 80% of the rose cultivation areas in Korea exhibited high resistance levels to almost all acaricides used, suggesting the utmost necessity of alternative control methods (i.e., biological control), whereas alternative acaricides can be proposed for remaining mite populations. The integrative resistance trait would serve as a useful parameter to combine all resistance information, from which a proper practical management action can be deduced.

Medical and Veterinary Acarology

In vitro* feeding of hard ticks: Studies on *Ixodes ricinus* and *Dermacentor reticulatus

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The artificial tick feeding has great potential to inspire research on ticks and tick-borne diseases. The development of *in vitro* feeding techniques for ixodid ticks is however impeded by the complexity of tick feeding behaviour and the long duration of blood feeding. Despite the fact that the first experiments on this subject were performed 100 years ago, all methods developed thus far result in poor feeding- and reproduction ratios compared to ticks fed on animals. They are also laborious since regular blood changes are typically required, which has hampered the adaptation of these techniques in the field. In the 'Optimization and Automation of Artificial Tick Feeding' (OAKS) project, efforts are undertaken to optimize the *in vitro* feeding for selected ixodid tick species of medical importance in order to develop a technique comparable to *in vivo* feeding concerning effort and rearing success. The effect of parameters such as blood storage temperature, blood supplements, environmental conditions and mechanical and olfactory attachment stimuli are being studied using a modified version of the silicone membrane feeding system which was originally developed at the University of Neuchâtel, Switzerland. Using this system, the life cycle of *Ixodes ricinus* could be completed *in vitro*. A second semi-automated tick feeding system was developed, in which glass tick chambers are fitted in a flow-through chamber through which a defined amount of blood is pumped. Preliminary results showed that the average weight of engorged *Dermacentor reticulatus* females fed using this system did not significantly differ from that of *D. reticulatus* females fed *in vivo*. Further investigations on critical factors and methods to further simplify the artificial feeding will be pursued in the remaining period of the OAKS project.

Quality control of house dust mite allergenic extracts through the study of allergen-related enzymatic activities

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House dust mites (HDM) are the most important source of indoor allergy worldwide, being *Dermatophagoides pteronyssinus* (Dpt) one of the most widespread species. Diagnosis and treatment of allergy against HDM is currently based on allergenic extracts obtained from large-scale cultures. Two major allergens, Der p 1 and 2, are



currently monitored using specific antibodies to achieve standardization. However, given the wide repertoire of allergenic proteins produced by Dpt (n=18), remarkable variability on allergen content is being observed in the detailed analysis of commercial products. Half of the known Dpt allergens are enzymes, including endoproteases (Der p 1, 3, 6 and 9), alpha-amylase (Der p 4), chitinase (Der p 15), glutathione S-transferase (Der p 8) and arginine kinase (Der p 20). Taking advantage of the enzymatic nature of Dpt allergens we aim to develop a method that allow the quality control of extracts obtained from mite cultures or their fractions. The study of 13 enzymatic activities on mite culture extracts reveals distinct profiles comparing phases of culture growth, or fractions of purified bodies and faeces. Activities related to allergens with a putative role in digestive physiology such as Der p 1 (cysteine protease), Der p 3 (trypsin) and Der p 6 (chymotrypsin) were higher in faeces than in bodies and showed a constant increase during culture growth, even after saturation. In contrast, activities related to allergens with intracellular functions such as Der p 8 and 20 were negligible in faeces and showed a decrease of activity after culture saturation. Our results highlight the critical importance of source materials (whole mite cultures, fractions of purified bodies or faeces, and mixes of them) on the final composition and consistency of commercial products. The inclusion of the described methodology in industry-based control procedures would help in improving the efficacy and safety of diagnosis and immunotherapy products.

Undiagnosed Demodecosis is one of the causes of failures of clinical medicine of the early 21st century

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As the WHO states, currently noncommunicable diseases (NCDs) are the major cause of death worldwide, causing more deaths than all other causes combined, and their prevalence has reached epidemic proportions. Despite the efforts of medicine, growth and aggravation of NCDs are not amenable to correction yet. The WHO notes: all countries of the world suffer effects of NCDs for human, social and economic dimensions. NCDs are slowly progressive and long-running diseases, which include allergic, cardiovascular, endocrine, oncologic, dermatological, gastrointestinal and other ones. Demodecosis is a primary chronic infectious associative disease. It was diagnosed in 96% of the 388,780 people when inspecting the entire skin covering and in 98% of the 2 million people from across the world when inspecting the exposed parts of the body. Acarological examination of 17,823 affected found: *Demodexes* in 98.1%, *Dermatophagoidesses* in 0.5%, *Sarcoptes scabiei* in 0.6%, unidentified mites in 0.8%. In 2.4% of the examined were found concurrently *Demodexes*, *Dermatophagoidesses* and *Sarcoptes scabiei*. Colonies of *Demodexes* were found in 100% of: in the skin papules of 242 patients with itching diseases, in acne elements of 247, in atheromas of 18, in chalazion of 12 patients. In 18 people with healthy skin all of the available methods of diagnostics failed to detect mites from the skin. Over 42 years, we have observed the avalanche-type spread of Demodecosis and growth of its various complications among the population. Of 42,980 patients that had sought treatment, 92% fully recovered after the anti-demodectic treatment. Before resorting to us, these patients had been treated unsuccessfully at ophthalmologists (1.4%), rheumatologists (1.2%), oncologists (0.5%), gynecologists (0.4%), endocrinologists (0.4%), surgeons (0.3%), urologists (0.2%), psychiatrists (0.1%) and other physicians (0.4% of patients). The largest number of the admitted patients had allergic (57.7%) and dermatological (37.4%) diagnoses because we provided chargeable services to patients with allergic diseases of the skin. Details on www.allergy.kz. These facts together with the WHO information allow asserting that the lack of diagnosis of Demodecosis and its mentioned clinical masks is one of the reasons for the currently rising incidence of NCDs. The independent researcher is up to prove this opinion by complete cure of patients with various Demodectic variants of NCDs on the background of acarological monitoring over time.

Cultural Acarology

Of mites and women

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Since the beginning Acarological studies were conducted by men, starting with Aristotle (350 BC) who named the tiny animal *akari*, and which Linnaeus (1758) latinized to *Acarus*, the type for the group. Many of the early and, to a large extent, basic works are due to male acarologists as Fabricius, Koch, Dugès, Berlese, Donnadieu, Megnin, Claparède, Canestrini, Kramer, Grandjean, to name a few. However, there is a considerable number of Lady acarologists, from all continents. And, in ancient times, there were two notorious Ladies who, although they make no reference to an acarine, recognized a human parasitosis – scabies – and developed efficient cures for it. Hildegard von Bingen (AD 1098 – 1179), a Benedictin nun, who other than having a strong theological and political activity, developed a cure for scabies which is registered in her *Liber simplicis medicinae – causae et curae*. She was beatified in 1548 and her holiness reconfirmed in 2012 when Pope Benedict XVI nominated her Doctor of the Church. Thus, we might well say that there is a Saint Acarologist! On the more profane side, there is a brief record from the years 700, of a probable romance of Florinda, the daughter of a noble of a clan in Iberia, who fell in love with a noble of a rival clan; but, according to other sources they were so intimate that she pulled the “aradores” (scabies mites) with a golden thread from his skin lesions. Or, could she have been a spy? This would allow to paraphrase the commonplace of detective or intrigue stories, *cherchez la femme* to *Cherchez la femme qui cherche l’acarien!*

Climate change and bioinvasions as interconnected challenges

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Environmental change and biological invasion in Japan – how we should encounter increasing invasive alien species?

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Habitat destruction and anthropogenic transfer of organisms by human activities would accelerate biological invasion. Furthermore global warming and heat island caused by over-use of fossil fuel are changing the adaptability of invasive alien species to new habitats. In Japan a lot of invasive species have already been established and expanded their distribution. Recently it has become a serious environmental problem that invasions by tropical or sub-tropical species are increasing. We here introduce our on-going study project for control of the following invasive species in Japan. We are investigating and predicting the ecological process of their biological invasion using phylogenetic evolutionary analysis and ecological niche modeling. And we will discuss the countermeasure against these invasive species. 1) The argentine ant *Linepithema humile* and the fire ant *Solenopsis invicta* from Latin America. 2) The red-back widow spider *Latrodectus hasselti* from subtropical region of Australia. 3) The commercialized stag beetles and parasitic mites on them from the South-East Asian tropical rain forest. 4) The ticks and tick borne diseases infesting the exotic pet animals. 5) Chytrid fungus *Batrachochytrium dendrobatidis*, a causative agent of chytridiomycosis, threatening amphibian in the tropical rainforest of Latin America and Oceania. These studies are supported by the Global Environment Research Fund (F-081, D-1101, and D-1401, Leader: K. Goka) of the Ministry of the Environment, Japan, 2008-2016.



Increasing risks for the expansion of *Brevipalpus*-transmitted viruses under global warming conditions

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Several plant diseases characterized by localized lesions on plant organs are currently attributed to viruses transmitted by *Brevipalpus* mites (Acari: Tenuipalpidae) (BTV). Citrus leprosis is by large the best known and most important economically of such diseases, but others as coffee ringspot, orchid fleck and passion fruit green spot also cause yield losses. Additionally, many ornamentals were found to be susceptible to BTV either naturally or experimentally. So far only three *Brevipalpus* species have been identified as vectors for BTV, respectively *B. phoenicis sensu lato*, *B. obovatus* and *B. californicus*. These species have worldwide distribution mostly in tropical and subtropical regions. Global warming may increase the area of distribution of these mites as well as of the diseases they transmit. Furthermore, these risks are amplified because of the ever-increasing world trade of plants, especially ornamentals. In addition, many of these plants host BTV and *Brevipalpus* and may act as Trojan horse, introducing the above-mentioned diseases into presently disease-free regions. Efficient BTV and *Brevipalpus* spp. detection protocols in the quarantine services would be required to minimize such a risk.

Climate change alters biogeography of spider mites and their natural enemies: consequences for biological control and food production

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Climate change influences the ecology and distribution of crops, pests and their natural enemies with potentially important consequences for food production and safety. To better understand climate change effects on agricultural ecosystems we investigated the impacts of changing conditions on a crop-pest-natural enemy system of global importance: tomato (*Solanum lycopersicum*), the two-spotted spider mite (*Tetranychus urticae*) and two key predators, *Neoseiulus californicus* and *Phytoseiulus persimilis*. We modelled the suitability of future climate for the four species using the CLIMEX model, which combines data on climate and species biology to calculate the Ecoclimatic Index, a measure of the potential for population growth. Data under two IPCC SRES climate change scenarios (A1B, A2) and two General Circulation Models (CSIRO MK3.0 and MIROC-H) for 2030, 2050 and 2070 were used for the projections. The results of the study suggest that in the near future, the climatic conditions at high latitudes in Europe, Asia and America as well as in hot and arid Mediterranean regions and areas in the tropics and sub-tropics, will become marginal for the maintenance of viable predator populations in contrast to populations of *T. urticae*, which are projected to be vigorous. Consequently, climate change is expected to negatively affect biological control of *T. urticae* in large swaths of agricultural land. Moreover, climate change is expected to shift outdoor tomato production northwards in Europe, a result of combined abiotic and biotic (*T. urticae*) stress. The current study highlights the importance of considering trophic interactions when predicting climate change effects on food production. Further work focuses on validating model projections with field data.

Biological Invasions in Changing Ecosystems

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The rate and extent of invasions is expected to grow as a consequence of global change effects in biological communities. While temperature is often considered as the main driver, other commonly recognized elements of global change are drought and land use change, which may facilitate drastic species range shifts and affect consumer-resource dynamics. Bioinvasions and global change must be then seen as interconnected challenges that pose a growing threat to ecosystem services, such as biodiversity and food security. Mites are particularly notorious invasive organisms both in terms of numbers of species, as well as for their ecological and economic impacts, and the number of destructive alien Acari species is increasing steadily. We outline here new tools and approaches (e.g. genetic markers, modeling) that contribute to understanding the main mechanisms by which species invade new habitats and also provide important insights into invasion risk. We emphasize the importance of scientific risk assessment and policy for the management of invasions under global change.

Neotropical phytophagous mites in Europe – current and potential invasions

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Invasive pests are among major impediments for agricultural productivity and can seriously affect biodiversity. Phytophagous mites are prone to become invasive pests due to their common cryptic habits and adaptability to new host plants and environments. However, whether a newly introduced species becomes invasive or not mostly depends on the biological and physical characteristics of the environment where it was introduced, which are greatly influenced by climate. Although similarity between Western Palearctic and Neotropical climates is limited, some species of phytophagous mite species probably native from the Neotropics have become invasive in Europe. These species currently present limited or wide distribution, affecting crops both under unprotected or greenhouse conditions. Some examples are the Texas citrus mite, *Eutetranychus banksi* (McGregor) and the tomato russet mite, *Aculops lycopersici* (Tryon), to whose management still being challenging. Climate change is expected to potentiate the number as well as distribution of invasive species by allowing: the success establishment of new invasive species in localities where climate conditions were unfavourable but became suitable; the enlargement of the altitudinal or latitudinal distribution range of invasive pests. In this context invasive mites originated from or established in the Neotropical region that could affect European agricultural systems will be pointed out. Pest risk analysis should consider both current and future climate change scenarios as well as associated agricultural landscape changes.

Detection and identification of invasive mites and regulatory measures: a global overview

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Plant feeding mites are usually microscopic and camouflaged, making them difficult to detect at ports of entry worldwide. Increased international trade in agricultural commodities and world climate change has resulted in increased interceptions of potentially invasive mite species. The most commonly intercepted economically important plant feeding mites are Tetranychidae and Eriophyidae, but species in the Tenuipalpidae, Tarsonemidae,



Tuckerellidae, Penthaleidae and stored products Acaridae (i.e. bulb mites, mold mites, cheese mites) have been increasing. In addition, other mite families (i.e. Tydeidae, Iolinidae, Phytoseiidae, Winterschmidtidae, etc.) associated with plants but usually not considered plant pests are being intercepted in increasing numbers. These mite families include many important economic pests or potential pests of crops, fruit trees, stored products, forests, ornamentals, cattle and humans. Trade from regions of the world where there is little or no information on the local mite fauna make it difficult to identify potential invasive species. The primary instrument used to identify regulatory mite pests is the light microscope, but preparation techniques and quality of the microscopes used and images obtained may lead to misidentifications. The use of phase contrast and DIC microscopes can help avoid some of these problems. In addition, user friendly scanning electron microscopes (SEM) (i.e. variable pressure table top SEM and low temperature-SEM) are helping to identify new mites and understand their potential as invasive or adventive species. We will be presenting the value of these technologies together with data on mite interceptions.

Effect of drought stressed plants on spider mites and impact on outbreaks

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Climate change (CC) is expected to bring water shortage for irrigated crops in semi-arid environments. Lower irrigation scheduling may greatly contribute to save water in summer crops, but it will also promote drought stress, which will have an effect on plant-herbivore interactions. Changes in both plant nutritional compounds and defenses are common in response to water stress in plants. The performance of phytophagous arthropods on drought-stressed plants will then depend on the balance of induced nutrients and chemical defenses in the plant, and how herbivores adapt to these changes. Here, we explored, under laboratory conditions, the effect of water-stressed tomato plants on the development of the two-spotted spider mite *Tetranychus urticae*. Our data reveal that drought stressed tomato plants induced significant changes on the nutritional quality (increase on aminoacids and free sugars) of the tomato plants. These changes trigger on key biological traits of tomato-adapted and non-adapted *T. urticae* strains that appear to be beneficial to mite performance. However, tomato plant defense proteins (protease inhibitors and peroxidases) were also induced by both drought and mite infestation, being the response generally higher to the non-adapted strain. How much these contrasting results can be explained by plasticity of mites in response to drought-stressed plants was further explored by studying field populations of *T. urticae* originating from a wide geographic range in the EU and experimentally challenging mites in the laboratory to simulate CC conditions. The resulting increased plant damage and outbreaks expected to rise under climate change conditions are discussed.

Forensic Acarology

Seasonal abundance of mite markers of decomposition stages

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Outdoor decomposition of exposed corpses and carcasses is dominated by scavengers; predominantly arthropods such as insects and mites. These arthropods arrive in waves that correspond to different stages of decomposition, and a time frame related to these stages and particular species can be drawn. However, the process of decomposition differs substantially between seasons, as their colonisers do. While insect markers have been fully studied for most parts of Europe, little exploration of the mites associated with decay underneath corpses has taken place. Determining the mite fauna associated with carcasses at different stages of decay directly impact of case-work in forensic analysis. Mites can inform of time of death, movement of bodies and circumstances of death. Therefore, it is critical to study the variations of the mite fauna along the decomposition process at different

times of the year. The soil underneath pig carcasses was analyzed for mite diversity at different stages of decomposition: Fresh, Bloating, Active decay, Advanced decay and Remains. The experiment was repeated four times, using the four seasons: Autumn, Winter, Spring and Summer. The effect of ambient factors such as temperature, light intensity, pH, rainfall, moisture content and wind on stages of decay was investigated. Like most other arthropods (insects) commonly used in decomposition studies, mites showed significant variations in abundance and diversity between stages and particularly for seasons.

Reviewing the house dust mite fauna: Its value as indoor trace evidence

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House dust mites (HDMs) are micro-arthropods collected from a variety of indoor microenvironments, which humans also inhabit. Although a multitude of factors, including relative humidity, altitude, light and temperature affect mite composition, the main influence regarding HDM fauna within the home are the people themselves. The variation between individual humans will allow for great diversity in the mites isolated from clothing, as well as on the various furniture in different rooms of the home. There are also diversities between mites collected from different biogeographical realms around the world, evident through the published literature on mite abundance and distribution. As such, it has been proposed that HDMs may be used in a forensic capacity as trace evidence. Current types of trace evidence used in forensic investigations, such as fibres, have a disadvantage with a lack of DNA, a benefit to applying mites in this manner. There is a problematic deficit surrounding this, as mite species do not differ greatly between localities, given a similar lifestyle of the houses' occupants and environment. Molecular genetics can assist with this. Microsatellites (short repetitive sequences of DNA) will be developed for loci illustrating a high degree of discrimination between mite populations of the same species. Molecular methods will be adapted for work on these mites. This would allow mites to become a model organism for trace evidence, and can be applied by forensic investigators in a similar manner to pollen DNA testing; to link a person or object back to their original location, at a specific point in time. It is important to identify high-resolution markers for this application, which is where the premise of my current research lies.

Traces of before death: Survival of mites in relocated wrapped bodies

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In order to assess the importance of mites and their potential use as trace evidence in the re-location of dead bodies, a first experiment of its kind in the UK was conducted. Six pig carcasses weighting ~ 55 kg each were used in two outdoor experiments. The experimental design recreated a primary and a secondary crime scene involving mite traces from a particular locality. In order to reduce variations in the decomposition process identical siblings were used. Straight after death, three siblings were dressed and concealed inside a blanket; any traces that came from the environment before death were protected from being disturbed. Then the pigs were transferred to forests located 60 and 200 miles South of the place of death. The blanket was used in the same way as in a crime case that happened in London three years earlier. The three other siblings were used as controls and laid naked on the same forest ground, under a similar plant canopy. The objectives were to find out whether mite species unique to the original locality could still be found in/on the re-located carcasses in a forest after decomposition took place, and if the concealment of bodies has a direct effect on the mite fauna.



New observations on carrion-associated mites in North America

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The mite fauna of vertebrate carrion in North America is generally similar to that of Europe in terms of families and genera, however, species determinations remain problematic. New observations from the southern and western United States update information presented in this symposium 4 years ago. The histiostomatid genus *Hexanoetus* has been recovered from carrion and trogid beetles, and two new, unidentified taxa of Mesostigmata were collected from carrion in Texas. The latter have not been assigned to any family.

Mites as trace evidence in a homicide case in Switzerland

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While walking on one of the paths of a natural park in Switzerland, a visitor and his dog discovered skeletal human remains scattered over a small area of the surface of the soil. Only a few bones were left behind in the forest. DNA analysis of a well-preserved fragment of bone allowed just the identification of the deceased. It was the analysis of the micro-invertebrate fauna associated with the remains what helped explain the circumstances of death. Several samples of soil, including controls, were collected and the micro-invertebrate fauna isolated and analysed. Mites were abundant and became the most informative markers. This presentation will discuss how these mite traces alone enabled plausible predictions for: i) a rough estimation of the time of death; ii) the circumstances surrounding the moment of death; iii) the primary crime scene or where the killing might have taken place; and iv) a likely movement or re-location of the corpse, including an estimation of the stage of decomposition at the time of re-location; and v) the manner the disposal of the human remains on the forest soil was performed.

The mite fauna of graves and the use of mites as forensic indicators in two case studies

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The most prevalent outdoor crime scene is that of buried bodies in shallow graves at depths of up to 50 cm. In general, the fauna of a buried body excludes many of the forensically important arthropods such as species of Diptera and Coleoptera that can colonise remains above ground outdoors, consequentially forensic investigations based on entomological data can become extremely difficult. Much like carrion insects, mites colonise carrion in a successive pattern; specific species attracted to different stages of decay. Mites are the most abundant micro-arthropods in soils and are even present at profound depths. Mites are able to colonise buried remains where carrion insects are deficient, absent or have difficulties reaching a corpse or carcass deep in soil. Along with the regular soil mite fauna that will colonise a cadaver, phoretic mites are amongst the first arthropods to arrive at a corpse along with carrion insects. Their unique characteristics such as host-specificity and habitat-specificity have huge potential, for example, as trace evidence and as indicators of time, like in post mortem interval estimations in homicide cases of graves and illegal mass graves. A discussion of two case studies, one from Scandinavia and one from Central Europe will illustrate the occurrence of mites and their value as trace evidence in relation to shallow graves. Mites were recovered from both crime scenes and sent to Reading University, U.K, for further analysis. In case study 1, the body of a male discovered in a shallow grave in Scandinavia, gave mites identified as of family Acaridae and Parasitidae. In case study 2, two corpses were found in a shallow grave in Central Eu-

rope and only Parasitidae mites were collected. The occurrence of the identified mite species was analysed and the potential of their use as forensic indicators will be discussed.

Ticks and corpses

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Studies on the arthropod community associated with human and animal decomposition have highlighted the occurrence of haematophagous acarines, particularly ticks (Ixodida), in/on or surrounding the remains. It is well known that outdoor corpses and carcasses attract a number of vertebrate scavengers, such as foxes, dogs, cats and vultures among others, and that these animals easily become the next host of ticks wandering on or around the remains. In a same manner, scientific police recovering evidence during crime scene investigations are exposed to tick infestations. The extent of the use of human and animal remains by ticks has not been fully appreciated. Analyses of the acarological fauna of carcasses have revealed that ticks do not only passively wait or wander over animal decay. Recent surveys indicate that the almost cosmopolitan species *Ixodes ricinus* makes use of other unique means of dispersal to reach a new host. Phoresy of *I. ricinus* on necrophagous flies or beetles seems to be more widespread and frequent than previously thought. A discussion on tick associations with the decomposition environment will inform on tick adaptations to this unique habitat, to the phoretic behaviour and, to how tick occurrence might introduce modifications of the risk assessment of evidence collection during crime scene investigations.



ABSTRACTS: POSTERS PRESENTATIONS

Morphology and Physiology

A description of teratologies in the *Dermatophagoides pteronyssinus* (Acari: Pyroglyphidae) house dust mite species

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Allergic pathologies currently affect, in Europe only, over 150 million people and, according to data supplied by the *European Academy of Allergy and Clinical Immunology* (EAACI), it is expected that more than half the European population will suffer from some form of allergy over the next decades. An allergy is a chronic disease with a high risk of a worsening of symptoms which significantly reduce quality of life in patients and increase the economic burden for public health systems. Allergenic extracts from mite species that induce allergic processes are required for diagnosis and immunotherapy, meaning that it is essential to mass rearing them under controlled laboratory conditions. The purpose of this paper is to document some of the morphological anomalies found in *Dermatophagoides pteronyssinus* (Trouessart, 1897) (Acari: Pyroglyphidae) specimens rearing under controlled conditions. For this purpose, a sample of 340 mites of both genders was taken and observed under a phase contrast microscope to determine whether teratologies were present. The sizes of the adult females observed were compared with those of the lectotypes and paratypes of the species. It was also concluded that these teratologies appeared in low frequency (1.29 %), and that the most commonly observed malformation was the duplication of the seminal duct and the spermatic receptacle.

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Maternally transmitted *Wolbachia* in predatory Phytoseiidae mites used as biological controls

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Maternally inherited *Wolbachia* in predatory Phytoseiidae mites has been investigated throughout recent years – with varying findings. It is a fairly consistent argument that these mites can/do harbor the bacteria – but it is often attributed to possible gut contamination due to the prey carrying the bacteria much more commonly. Overall, there are varying results within this study area. We have utilized previously unused techniques to identify endosymbiotic bacteria from adult mites as well as their eggs – in order to assess the maternal transmission nature of the *Wolbachia* found within these groups. Advances, we believe, can be made on this subject by the use of Fluorescent In Situ Hybridization (FISH) techniques – coupled with standard and more sophisticated PCR procedures – to give a detailed understanding of the whereabouts and maternal transmission of the *Wolbachia* bacteria. Use of FISH on eggs allowed us to assess occurrence and localization of *Wolbachia* at very early stages. A strong signal of *Wolbachia* detected throughout the body and gut of predatory Phytoseiidae mites initially gave the impression of gut contamination. However, the same signal present in the ovaries as well as the individual egg squashes adds more clarity to the maternal transmission argument. This coupled with PCR results from starved Phytoseiidae mites confirm that two out of three species tested harbor *Wolbachia* – even after periods of not feeding.

Taxonomy, Systematic and Phylogeny

New species of *Opilioacarus* from Italy (Parasitiformes: Opilioacaridae)

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Opilioacarida is a poorly known soil mite group, with the first genus described from Algeria and *Opilioacarus segmentatus* With as type species. *Opilioacarus italicus* (With), the second identified species, was described based on a single immature specimen collected in Sicily, Italy. By today's standards, *O. italicus* description is insufficient for a proper identification, with many features based on the color or leg size, quite common characters within other Opilioacaridae species as well. The *O. italicus* holotype is not available anymore. To make a proper diagnosis of this species, material collected and identified as *O. italicus* by Paolo Marcello Brignoli, was requested and loaned by the Museo Civico di Storia Naturale of Verona. The material was clarified in lactophenol and then washed in distilled water, dissected and mounted in Hoyer's medium. In this material was possible to identify two new species, both with females and males specimens, one in Apulia and one in Sardinia, Italy. All were diagnosed as *Opilioacarus* genus, presenting *d* foliate setae, 3-6 dorsal and 2 ventral setae on the pre-anal segment. Both species present an additional pair of solenidia in main sensilla group on telotarsus I, *d* palptarsus setae shape similar to *O. segmentatus* and the presence of eugenital setae. *Opilioacarus* sp.n.1, from Apulia, presents more setae on palps than *Opilioacarus* sp.n.2, from Sardinia. The combination of two different types of *d* setae is uncommon in Opilioacaridae. The only species known to present such character is *O. segmentatus* (Bou Saad, Algeria, type locality), according to some Grandjean illustrations. These groups speciation probably happened by vicariance, before the formation of the Mediterranean Sea and also the Tyrrhenian Sea, separating both lands and acting as a natural obstacle.

New species of *Heterozercon* from Brazil (Parasitiformes: Heterozerconidae)

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Heterozerconidae is a small group of mites, comprising 19 species distributed in 7 genera, mostly associated with Diplopoda, snakes or termites nests. In Brazil, 4 genera were registered: *Amheterozercon*, *Heterozercon* and *Zeterohercon* all from the southeast areas and *Maracazercon* from northern ones. Soil material was collected during a survey in caves close to Altamira city (Para State, Brazil) realized by the Laboratory of Subterranean Studies, Federal University of Sao Carlos, under the supervision of Prof. Dr. Maria Elina Bichuette. The specimens, both females and males, was clarified in acid lactic, washed in distilled water and mounted in Hoyer's medium. Observations led to the identification of two new species, tentatively placed in the genus *Heterozercon*. The specimens of both species, when compared to others of the same genus, present the ophistogenital shield much broader, small suckers not set close to the anus and a variation in the size of the setae located at posterior lateral margins of the body. *Heterozercon* sp. n.1 presents evident differences when compared to *Heterozercon* sp. n. 2: 1) ophistogenital shield broader, 2) spermadactyl smaller, thinner and not twisted, 3) larger adult body sizes, 4) legs setae and spines larger and unequal. The male spermadactyl of *Heterozercon* sp.n.2 resembles a Brazilian species *Maracazercon jolivetii*, belonging to another genus, having a twisted and long spermatodactyl while the long serrated movable digit is similar to *Zeterohercon amphisbaenae*. Some characters of both species do not fit in the *Heterozercon* genus. Hence, the option to propose a new genus seems acceptable, yet it might be better to wait for the analysis of other specimens before the creation of this genus to avoid further proliferation of generic names.



Introducing of some oribatid mites (Acari: Oribatida) of Maragheh and Bonab regions, Iran

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Oribatid mites are a large group of soil mites. They form an important part of detritus food webs, and most species feed on fungi and litter, and their role in decomposition of dead organic matter is significant. A faunistic study was conducted during 2015. Soil samples of Maragheh and Bonab regions in northwest of Iran, were taken and transferred into the Acarology laboratory, Faculty of Agriculture, University of Maragheh. Mites were extracted using a Tullgren apparatus, cleared in Nesbitt's fluid and were mounted on microscope slides using Hoyer's medium. In this study, 11 families, 14 genera and 16 species were identified. Among them, one species is new and is marked by an asterisk. List of species are as follow, Nothridae: *Nothrus biciliatus* Koch, 1841. Epilohmanniidae: *Epilohmannia cylindrica cylindrica* (Berlese, 1904). Phthiracaridae: *Phthiracarus lentulus* (Koch, 1841); *Stegnacarus carinatus* (C.L. Koch, 1841). Euphthiracaridae: *Acrotitia ardua* (Koch, 1841). Damaeolidae: *Fosseremus laciniatus* (Berlese, 1905). Eremulidae: *Eremulus flagellifer* Berlese, 1908. Licnodamaeidae: *Licnodamaeus sp. nov.* Tectocepheidae: *Tectocepheus velatus* (Michael 1880); *T. minor* Berlese, 1903. Oppiidae: *Anomaloppia dispariseta* (Hammer, 1958); *Oppia nitens* C. L. Koch, 1836; *Rhinoppia obsoleta* (Paoli, 1908). Scheloribatidae: *Schelorbates laevigatus* (Koch, 1835). Hypochthoniidae: *Hypochthonius rufulus* C. L. Koch, 1835; *H. luteus* Oudemans, 1917.

Feather mite fauna (Acariformes: Analgoidea and Pterolichoidea) of Meghalaya (India) -preliminary data from three scientific expeditions

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Feather mites (Acariformes: Analgoidea and Pterolichoidea) are mutualistic symbionts that can be commonly found on birds. So far, over 2500 species of feather mites have been described, and experts believe that the currently known number of species represents less than 15% of the existent species. The diversity of feather mites in India is poorly known, data on species recorded in this country are scattered among various taxonomic works. Considering that the avian fauna of India includes over 1300 species of which 644 are present in Meghalaya, and each of them is a potential host for several feather mite species, it is obvious that the investigation of feather mites in this country is in a very early stage. The studied acarological material was collected by authors in three scientific expeditions organized in Jaintia Hills District (Meghalaya, Northeast India): Khahnar (February, 2013), Shnongrim (January, 2014) and Kharkhana (October, 2014). The birds were captured, identified and visually checked for the presence of mites and, after the mites were collected, released back into the wild. In these three expeditions were checked 214 birds (belonging to 59 species) of which 180 (belonging to 52 species) showed feather mites. Until now it has been identified acarological material from 98 specimens of bird hosts, belonging to 24 species, and we found 38 species of feather mites. All these species of feather mites are new records for fauna of India and, more than that, 11 species were new to science and have been already published in a series of papers.

A newly recorded mite species from Turkey: *Eupalopsellus deformatus* Fan (Acari: Eupalopsellidae)

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Eupalopsellidae Willmann is a family within the superfamily Raphignathoidea. This family comprises five genera, including *Eupalopsellus* Sellnick. Up to now nineteen species belonging to the genus *Eupalopsellus* are known

in the world, three of which, *E. olandicus* Sellnick, *E. rostridius* Summers and *E. prasadi* Bagheri & Khanjani, are recorded from Turkey. An additional species, *E. deformatus* Fan, ex lichen and moss from Örümcek Forest, is herein described and illustrated. This species was only given before from the type of locality China, and later Iran. This is the third report of the species for now.

A new locality of *Stigmaeus kelkitensis* Dönel & Doğan (Acari: Stigmaeidae)

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The family Stigmaeidae is the most abundant in the superfamily Raphignathoidea and consists of 32 genera. *Stigmaeus* is one of the richest genera in the family. To date 33 species including *Stigmaeus kelkitensis* Dönel & Doğan are known from Turkey. This species was only given from the type locality, Kelkit Valley (Turkey) by now. In the present study, 12 female specimens of this species were found from Harşit Valley, Turkey. This is the second report of *S. kelkitensis* in the world. The type specimens of the species were collected from litter under *Quercus* sp. and *Juniperus* sp., whereas new specimens were collected from grassy soil. Structural differences between the specimens collected from Kelkit and Harşit Valley were emphasized.

An additionally known member of the genus *Barbutia* (Acari: Barbutiidae) from Turkey: *Barbutia iranensis* Bagheri, Navaei & Ueckermann

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Barbutiidae Robaux is a small, rarely collected and uncommon family which consists of only one genus *Barbutia* Oudemans. The genus *Barbutia* comprises five species around the world; *B. anguineus* Berlese, *B. australia* Fan, Walter & Proctor, *B. iranensis* Bagheri, Navaei & Ueckermann, *B. longinqua* Fan, Walter & Proctor and *B. perretae* Robaux. To date, only one species was reported from Turkey: *B. anguineus* Berlese. An additional species, *B. iranensis* has been given with this study. On the bases of female specimens collected from Harşit Valley (Turkey), description and illustrations of *B. iranensis* were given here. This species was only known before from Iran, now it is also part of the mite fauna of Turkey.

Comments on the identity of *Kampimodromus ragusai* Swirski & Amitai, (Acari: Phytoseiidae)

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There are 15 nominal species of genus *Kampimodromus* Nesbitt (Acari: Phytoseiidae) belongs to the subfamily Amblyseiinae (Acari: Mesostigmata). They are characterized by having dorsal setal pattern 10A:8C with 18 pairs of dorsal setae (S4 absent) including sub-laterals (r3 and R1). All *Kampimodromus* species were described from the Western Palearctic region except for *K. alettae* (Ueckermann & Loots) and *K. molle* (Ueckermann & Loots) which are only known from South Africa. In this study, more than 50 specimens belonging to genus *Kampimodromus* were collected from *Quercus cerris* (Fagaceae) associated with tydeid mites *Tydeus* sp. (Acari: Tydeidae) in Mersin province Turkey. Preliminary observations, on the female specimens indicated that they were close to *K. aberrans* (Oudemans) in terms of number of solenostomes on the dorsal shield (bears four pairs of solenos-



tomes), dorsal setal measurements and calyx of spermatheca cup-shaped with atrium small nodular. However, movable digit dentition was different in the collected specimens. While *K. aberrans* has smooth movable digit, all specimens of *Kampimodromus* sp. has one tooth on that chelicera part. In addition, collected males also bears one more tooth on fixed digit of chelicera when compared to males of *K. aberrans*. As a result, all specimens of *Kampimodromus* sp. are considered as *Kampimodromus ragusai* Swirski & Amitai which is re-discovered for the first time after it is original description. This species is re-described and illustrated based on the female and unknown male. The species status of *K. ragusai* as a valid species within the genus *Kampimodromus* is discussed.

The mites species (Acari: Phytoseiidae) on vineyards of Turkey

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Turkey is the sixth largest grape producer country of the world. Especially dried grape exportation is important for Turkish economy. Among the grape pests, plant parasitic mites are common and they have negative effects on the yields. Large usage of insecticides cause to increasing of the environmental problems. Protection of the natural enemies have vital importance in order to increasing their efficacy. Phytoseiidae is the richest beneficial mite family, in vineyard ecosystems. Some of the phytoseiid species commercially available while many of others are potential for controlling of phytophagous mites. In this study, the mite species have been determined from vineyards of Ankara. The aim of this study was determination of beneficial mite species (Phytoseiidae) and their distribution from grape plants in Ankara regions of Turkey. The samples were collected mainly from most important grape producing area weekly interval during 2015–2016. All the obtained mite samples were evaluated in this paper. A total of 8 mite species were identified during the surveys. *Kampimodromus aberrans* (Oudemans), *Euseius finlandicus* (Oudemans), *Euseius finlandicus* (Oudemans) were the most common and highly populated beneficial mites in that region. The previous record of the grape phytoseiids were provided.

A preliminary comparative study on morphological and molecular characters of *Typhlodromus* (*Typhlodromus*) *athiasae* and *Typhlodromus* (*Anthoseius*) *recki* from Turkey

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Two predatory mite species naturally occur on Solanaceous vegetables and weeds as well as on some fruit trees in Bursa and Ankara (Turkey): *Typhlodromus* (*Typhlodromus*) *athiasae* and *Typhlodromus* (*Anthoseius*) *recki*. Although these species are simultaneously observed on same plants, their biology and food habits are reported to be different. Thus, species diagnostic is critical for biological control success. Furthermore, *T. (A.) recki* and some close species differ by the nature and/or the length of the macroseta (stIV) and dorsal idiosomal setae (S5 and Z4). There is also large variation in the presence of ventrianal pore within *T. (A.) recki*. Similar variations are also reported for *T. (T.) athiasae*. Also, no molecular data have been recorded, yet. First, the aim of this study was to investigate the morphological and genetic variability of *T. (T.) athiasae* and *T. (A.) recki*, based on morphometric analyses of 23 traits and a molecular analyse of the mitochondrial 12S rRNA fragment. Secondly, the variability within *T. (A.) recki* was evaluated by comparing populations collected on different plants in Bursa. Besides the discrepancy in number of solenostome, shapes of spermatheca and macrosetae and the present of S5 setae, significantly morphometric differences between these species were determined based on length of the setae, except some anterior lateral (z2, z3, z4) and anterior inter-tegument setae (r3). The genetic distance between these two species was 35%. Lengths of some setae (j6, Z5, StIV) were significantly different between *T. (A.) recki* specimens collected from Solanaceous plants and fruit trees, while no genetic variability was observed. This preliminary result confirms that the target DNA fragment is an excellent diagnostic tool. Further morphometric and genetic analyses in *T. (A.) recki* populations collected different plants in Mediterranean countries should be however planned to better assess intraspecific variations of the DNA fragment studied.

Mites associated with plants: the Laffi photo-repertoire

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The availability of good quality images on plant adversities is crucial for quick association of the findings with typical appearance of the alterations and their causal agents. This is relevant for plant feeder mites. It is fairly easy to acquire images of the symptoms induced by them but somewhat problematic to obtain acceptable pictures of individuals. Specific browsing on the Web return uneven, incomplete and rough images, frequently characterized by low quality. This, certainly, does not increase the curiosity and not conducive to the spread of knowledge about Acari in the various communities (students, curious, technicians). To partly fill this gap, it is presented a photographic archive with phytophagous mites present on Italian territory and the alterations they produce on plants, and making this collection soon accessible to Internet users. This repertoire also includes photographs of non-pest mites so as to provide an overall picture of the main groups that can be found on plants. The photo collection was created by Franco Laffi on material collected/studied mainly in Emilia Romagna area over three decades of activity. The extent of the collection explains the varying number of photos from species to species: the number of images is higher and comprehensive for the most common and harmful species of tetranychids and eriophyids observed and continuously investigated, lower for mites occasionally found or harmful to crops, even important, but present only in other Italian agricultural areas. On the whole, more than 800 images are available and they concern species validated by specialists of various taxa. As usable from net, these images represent a useful aid for anyone - agricultural technicians, students or researchers - interested in a very preliminary and fast classification of the various groups and to deepen the knowledge of mites living on plants.

Take a closer look! *Caleremaeus* (Oribatida, Caleremaeidae): An underestimated taxon

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Caleremaeus monilipes (Michael, 1882) is the only known (valid and recent) species of this oribatid mite genus in the Palearctic region. It represents a euryoecious species and can be found in different habitats (alpine meadows, alluvial forests, dry grasslands...) as well as in various substrates (mosses, lichens, soil, deadwood, algae...). Furthermore, *C. monilipes* shows a great vertical distribution from colline to alpine regions. Despite its relative minuteness (~400 µm) this species can easily be determined due to its characteristic habitus. We used a multidisciplinary approach including genetics as well as morphological and ecological data to assess if this easily recognizable, widely distributed and euryoecious mite taxon represents one and the same species. According to both, phylogenetic and species delimitation analyses five distinct entities were detected. These genetic lineages correlate well with ecological data. Subsequently, slight morphological differences between specimens of different clades were found. All examined individuals differ morphologically from the type material of *C. monilipes*. Thus, *C. monilipes* was not present in our dataset comprising specimens from the central-, southern-, and western- European mainland.



Grenadian *Thalassozetes* (Oribatida, Selenoribatidae)

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Only a few taxa of the mostly terrestrial oribatid mites (Acari, Oribatida) inhabit marine habitats. The majority of these coastal mite taxa, like the Selenoribatidae, belong to the superfamily of Ameronothroidea. The genus *Thalassozetes* Schuster, 1963 is a member of this family, and shows a transoceanic distribution and can be found in littoral habitats of the tropics and subtropics as well as of Mediterranean regions. So far, six species were described (or placed) within this genus: the type species *Thalassozetes riparius* Schuster, 1963 (Adriatic and Black Sea), *T. melanomerus* and *T. ugraseni* (Marshall & Pugh, 2000) from southern Africa (Mozambique and South Africa), *T. shimojanai* (Karasawa & Aoki, 2005) from Japan, *T. tenuisetosus* Bayartogtokh & Chatterjee, 2010 (western India), and *T. barbara* Pfingstl, 2013 (Barbados). The latter represented the first record of this genus in the Caribbean area whereas a recent investigation revealed additional occurrences of *Thalassozetes* on further islands of the Lesser Antilles. The present study focusses on *Thalassozetes* specimens from the island of Grenada, which is situated in the southeastern Caribbean Sea, approximately 250 km to the west of Barbados. Molecular genetic and morphological data were used to study several populations across Grenada. By means of nuclear and mitochondrial markers, the phylogenetic status and population structure was inferred.

Preliminary catalogue of the Flat mites (Acari: Tenuipalpidae) from Spain

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Flat mites (Acari: Tenuipalpidae) are exclusively phytophagous and include several pest species of economic plants. They may damage fruit crops in temperate regions and have been identified as vectors of plant viruses on tropical fruit crops and ornamental plants. Despite their economic importance, the knowledge of the species occurring on cultivated and non-cultivated, spontaneous plants in Spain is very scarce and almost restricted to a few economic species. A study on the diversity and host-plant relationships of flat mites was started in 2015, and we here present the first results. We studied specimens collected between 1983 and 2015 from different regions in Spain (excluding Canary Islands) on cultivated and non-cultivated plants. About 1200 specimens were examined and 35 morphospecies were identified. All the species belong to five genera: *Cenopalpus* Pritchard & Baker with eleven morphospecies; *Brevipalpus* Donnadieu with nine; *Aegyptobia* Sayed with seven; *Pentamerismus* McGregor with four and *Tenuipalpus* Donnadieu with four morphospecies. Associations between taxa and host plants were observed in some genera. Species of *Aegyptobia* and *Pentamerismus* frequently occurred on Cupressaceae, and *Cenopalpus* occurred mainly on Rosaceae, Labiatae and Pinaceae.

The *Aceria* species (Acari: Trombidiformes: Eriophyoidea) from southwest of East Azerbaijan province in Iran, with description of two new species

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The genus *Aceria* Keifer, 1944 includes the highest number of species within the superfamily Eriophyoidea. Summarizing the current literature, around 1000 name species have been assigned to this genus. The taxonomic status of many of them needs further clarifications. Until now, 68 *Aceria* spp. have been recorded in Iran. During the study on Eriophyoids in southwest of East Azerbaijan province (Iran), *Aceria zygofabae* n. sp. and *Aceria alkannae*

n. sp. were found and are here described and illustrated, respectively from *Zygophyllum fabago* L. (Zygophyllaceae) and *Alkanna bracteosa* Boiss. (Boraginaceae). Six eriophyoid species were recorded on plants of family Zygophyllaceae and three of them belong to *Aceria*. *Aceria zygofabae* n. sp. has no similarity with these species. The new species shows some similarities with *Aceria novellae* Denizhan *et al.*, 2007 collected from *Hedysarum* sp. (Fabaceae) in Turkey and they differ in the pattern of prodorsal shield, coxal ornamentation, empodial rays and length of setae *sc*, *e* and *3a*. *Aceria alkannae* n. sp. was compared with 10 known *Aceria* species collected from other Boraginaceae plants and shows similarities with *Aceria echii* (Canestrini, 1891) collected from *Echium vulgare* L. Differences between these two species (according to *A. echii* sensu Farkas, 1965) concern the prodorsal shield pattern, frontal lobe presence, number of annuli, empodial rays and length of *sc* setae. This is the first record of an *Aceria* species on a *Zygophyllum* sp. and *Alkanna*. In addition, five more *Aceria* species were identified, including *A. eucricotes* (Nalepa, 1892), *A. cynodonis* Wilson, 1959, *A. tosichella* Keifer, 1969, *A. chenopodia* Xue, Sadeghi & Hong, 2009 and *A. tristriata* (Nalepa, 1890) (protogyne and deutogyne). Among them, *A. cynodonis* and *A. tosichella* are new records for Iran eriophyoid fauna.

Palaeosomatid mites (Oribatida: Palaeosomata) from different soil horizons of grassland and agricultural habits in Iran, including a new species of *Adelphacarus*

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In a study on palaeosomatid mites (Oribatida: Palaeosomata) in the Marand region of East Azerbaijan Province, Iran, samples were taken from three upper soil horizons – I (0 to 18-36 cm depth), II (10-29 to 25-54 cm depth) and III (40 to 75 cm depth) – in wheat and sunflower fields, gardens and grasslands, during 2014. Representatives of two families, five genera, five species and five subspecies were identified. Among them: four species were from horizon I: nymphs and adults of *Aphelacarus acarinus acarinus* (Berlese, 1910) in wheat and sunflower fields, gardens and grasslands; adults of *A. acarinus* ssp. in wheat field, garden and grassland; adults of *Beklemishevia hispaniola* Perez-Inigo, 1997 in wheat field; adult of *Ctenacarus araneola* (Grandjean, 1932) in grassland; adults of *Gilarovella demetrii* Lange, 1974 in sunflower field). Two species were from horizon II: nymph and adults of *A. acarinus acarinus* in wheat field, garden and grassland; adults of *A. acarinus* ssp. in wheat fields; adult of *C. araneola* in grassland). Three species were from horizon III: adults and nymph of *Adelphacarus reticulatus* n. sp. in grassland; adults of *A. acarinus acarinus* in grassland; adults of *A. acarinus* ssp. in grassland; adult of *C. araneola* in grasslands). *Adelphacarus* has been monotypic since its proposal, and *A. reticulatus* n. sp. represents the first generic record from Asia. This species is easily distinguishable from *A. sellnicki* Grandjean, 1952 by several characters relating to body ornamentation, form of the sensillus, and length of body setae. *Aphelacarus acarinus acarinus* is newly recorded from East Azerbaijan Province and *B. hispaniola* is new for the mite fauna of Iran.

A new record of the genus *Echinothrombium* Womersley, 1937 (Acari: Microtrombidiidae) from Turkey

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Microtrombidiidae Thor is one of the most common families with 126 genera. This family consists of about 452 described species. They are well known worldwide, but have been poorly investigated in Turkey. The genus *Echinothrombium* Womersley has two species: *E. rhodinum* (C. L. Koch, 1837) and *E. spinosum* (Canestrini, 1885). This paper deals with the description of a *Echinothrombium* mite based on the Turkish material, *E. spinosum* (Canestrini, 1885), as a new record for Turkey. In this study, we aimed to contribute to the knowledge of mites present in Turkey. The following collecting methods were used: hand collecting and extraction in Berlese funnels. Examined material was preserved in 70% ethyl alcohol and cleared in 9% KOH. Specimens for light microscope studies were mounted on slides in Hoyer's medium. Measurements were taken in micrometers (µm) and the figures were taken under a Leica DM 4000 microscope with differential interference contrast (DIC) and phase con-



trast. In this study, only adult and deutonymph specimens of *E. spinosum* (Canestrini, 1885) were collected from humid meadow and on soil surface. This is the first report of *E. spinosum* from Turkey. In this study, the specimens of Turkey were compared with specimens of Europe. The figures of some body parts and worldwide distribution of *E. spinosum* were also provided.

Towards resolving the double classification in *Erythraeus* (Erythraeidae): matching larvae with adults using DNA and rearing

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Species of velvet mites were mostly described as adults in the early years, but have more commonly been described as larvae in the last decades. This has created a problem of “double classification” and applies to the majority of velvet mites. One of the most speciose terrestrial parasitengone genera, *Erythraeus*, comprises over one hundred nominal species. Only two species of these are known from both instars. How many of the names based on larval descriptions that actually represent the same species as a name based on an adult description is anyone’s guess. Previously, experimental rearing was the only option to connect all life history forms, where eggs and larvae were obtained from field-collected ovigerous females. However, such attempts have rarely been performed for Erythraeidae in the past because of sampling effort, captivity stress and the complexity of factors influencing parasitengone life cycles. An alternative today is to match larvae and adults with DNA, one of the most useful applications of DNA barcoding. Here we used the general mixed Yule coalescent method (GMYC) on a gene tree from 28S to explicitly test if field-collected specimens representing heteromorphic life instars were conspecific. Laboratory rearing and morphometric data was used to confirm the matching done by 28S sequence data. This integrative taxonomic approach of molecular, morphological and rearing data gives a higher support to the species delimitation and improves the metric data on the intraspecific variation. Redescriptions can now be made for *Erythraeus phalangoides* (De Geer, 1778), *Erythraeus cinereus* (Dugès, 1834), *Erythraeus regalis* (C.L. Koch, 1837), after modern standards, with a list of new junior synonyms and neotype designations.

New records of the genus *Carabodes* (Acari, Oribatida, Carabodidae) from Turkey

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In the present study, four species of oribatid mites of the genus *Carabodes* Koch, 1835 viz., *Carabodes* (*Carabodes*) *labyrinthicus* (Michael, 1879), *Carabodes* (*Carabodes*) *rugosior* Berlese, 1916, *Carabodes* (*Carabodes*) *pirinensis* Kunts, 1961 and *Carabodes* (*Flexa*) *dubius* Kulijev, 1968 were recorded for the first time from Turkey. The mite materials were collected from soil, litter, moss and lichen samples taken from Bolu province and extracted using a Berlese funnel apparatus. Mites were fixed and stored in 75% ethanol. The light and scanning electron microscopes were used to examine mites. The compound microscopic examinations of specimens were made in lactic acid, mounted in temporary cavity slides. For each species, morphological features and distributions were given. A key for the species known of the genus *Carabodes* from Turkey was also given.

Phytoseiid mites (Acari) on ornamental plants of Tokat province

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In this study was carried out Tokat province centraland 11 districts (Almus, Artova, Başçiftlik, Erbaa, Niksar, Pazar, Reşadiye, Sulusaray, Turhal, Yeşilyurt, Zile) in 2013-2014. Specimens were collected at weekly intervals from various areas and plants, including deciduous trees, conifers, parks, ornamental trees, home gardens, and shrubs in recreational areas of Tokat province. The samples were taken mainly from unsprayed areas during the growing seasons. Based on the survey results phytoseiid family mites belonging 6 species from 9 different plant species were identified. This mite species were *Typhlodromus pyri* Scheuten 1857, *Phytoseiulus finitimus* Ribaga 1904, *Typhlodromus cotoneastri* Wainstein 1961, *Typhlodromus athiasae* Porath and Swirski 1965, *Paraseiulus solieger* Ribaga 1902, *Euseius finlandicus* (Oudemans, 1915). *E. finlandicus* was the most abundant phytoseiid species. As it is already well known phytoseiid mites (Acari: Phytoseiidae) were used as biological control agents of phytophagous mites, thrips and whiteflies. In this article will be given information and distribution of six phytoseiid species also.

Phyllocoptes cacolyptae (Acari: Trombidiformes: Eriophyoidea), a new eriophyid mite of eucalyptus (*Eucalyptus* spp., Myrtaceae) in Liguria

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Several plant species are cultivated in Liguria for the market of the green cut foliage. The cultivation of species of *Eucalyptus* started in the 80's and currently it covers about 350 ha in the Districts of Imperia and Savona. During 2013 and 2014, stems of *Eucalyptus cinerea* F. Muell. ex Benth, *E. ovata* Labill and *E. pulverulenta* Sims cultivar Baby Blue exhibited morphological alterations associated to the presence of a new eriophyid species. The mite was named *Phyllocoptes cacolyptae* (Eriophyidae: Phyllocoptinae). It was found living freely on the surfaces of the green foliage. The infested plants showed the drying of the apical buds, causing the development of lateral buds in shorter internode stems, whereas the young leaves are smaller and thicker and tend to turn to a violaceous tone. The alterations were much heavier on *E. pulverulenta* cv. Baby Blue than on the other species surveyed. The plants with damaged shoots, even upon early infestation, can have no commercial value as much more handling is required for discharging the affected green parts during the selection and preparation of commercial bunches. This mite species was also found in the Department of Var (France). It is the first record of an eriophyid mite on gum trees in the European and Mediterranean basin. Remarks are provided on the eriophyid mites currently associated to *Eucalyptus* spp.

Taxonomic investigations on achipteriid mites (Acari, Oribatida, Achipteriidae) of the Harşit valley from Turkey

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The achipteriid mites inhabiting the Harşit valley (Turkey) were evaluated from the taxonomic point of view, based on samples collected in 2013 and 2014. The extraction of mites from materials collected from the investigation



area was made by using a Berlese-Tullgren funnel extractor. Extracted mites were killed, fixed and stored in 75% ethanol. The light and scanning electron microscopes were used to examine mites. The compound microscopic examinations of specimens were made in lactic acid, mounted in temporary cavity slides. Electron microscope photos of all determined taxa were taken. Four species belonging to the family Achipteridae Thor, 1929 were determined. Of these, *Campachipteria patavina* (Oudemans, 1914), *Campachipteria petiti* (Travé, 1960) and *Campachipteria* sp., are new records for the Turkish fauna; *Achipteria (Achipteria) nitens* (Nicolet, 1855) has already been determined in Turkey. As a result, the morphological features of all determined taxa were reviewed on the basis of our samples. Furthermore, the identification key to the known genera of the family Achipteridae from Turkey was arranged.

Biogeography and Biodiversity

Oribatid mite (Acari) fauna of Marmara region of Turkey

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Marmara region is one of the Turkey's main seven geographical regions and situated between the continents Europe and Asia. This region occupies the northwest corner of the country and represents 8.5% of the total area of Turkey with its 67.000 square kilometers of land. Marmara region comprises eleven provinces: İstanbul, Edirne, Kırklareli, Tekirdağ, Çanakkale, Kocaeli, Yalova, Sakarya, Bilecik, Bursa and Balıkesir. Information on the fauna of the region is very limited, especially concerning invertebrates. Although oribatid mites are one of the richest group of Acari with approximately more than 10.000 described species, studies on oribatid mites are very restricted with about 150 species from Turkey. Studies on the oribatid mites of Marmara region of Turkey have been ongoing since 2010. As a result of compilation of studies on oribatid mites totally 26 species and 2 subspecies were recorded from the region, namely: *Acrotritia hyeroglyphica*, *Amerobelba decedens*, *Amerus polonicus*, *Corynoppia andulau sakaryaensis*, *Corynoppia kosarovi*, *Ctenobelba (Caucasiobelba) urhani*, *Cymbaeremaeus cymba*, *Damaeolus ornatissimus*, *Dissorhina uludagensis*, *Epilohmannia cylindrica*, *Epilohmannia imreorum*, *Heminothrus peltifer*, *Hypochthonius luteus*, *Hypochthonius rufulus*, *Lasiobelba kuehnelti*, *Nanhermannia nana*, *Oppia nitens*, *Oppiella nova*, *Paralopheremaeus hispanicus arifi*, *Papillacarus ondriasi*, *Poecilochthonius italicus*, *Rhinoppia obsoleta*, *Ramusella neonominata*, *Tectocephus velatus*, *Zetorchestes grandjeani*. Eight of these species are new records for the Turkish fauna, two species and two subspecies have been described as new to science. As it will be understood from the examined material, limited numbers of sampling from a limited area contains eight new records, three new species and two new subspecies for our country which is an indication of the biological richness of the region. Therefore, we believe that by the evaluation of material collected by a more comprehensive field study both the Turkish and world of fauna will gain a much greater number of taxa.

Soil mesostigmatid mites as potential tool for bioindication concerning ecological status of forest

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Soil free-living predatory Mesostigmata mites of five different forests from Danube Delta Biosphere Reserve were analyzed in order to get information to define the conservation status of the investigated sites. The study is a comparative one being focused on mesostigmatid mites fauna from natural versus anthropogenic ecosystems. Three natural forests and two plantations represented by Canada poplar and, respectively, by willow trees were

selected. On the whole, in the five studied stands there were recorded 32 species of Mesostigmata, belonging to 22 genera and 14 families. The analyzed material includes new species of the Romanian fauna as well as rare and less cited species from other places in Romania. A quarter of the identified species was formerly found in the Danube Delta, two species being identified only within D.D.B.R. territory. Only two species were common to the majority of the investigated stands: *Hypoaspis nollii* and *Rhodacarellus silesiacus*, both of them being hygrophilous elements. The particular conditions of each stand (vegetation, type of soil etc.) as well as climatic conditions influence the structure of the mesostigmatid mites communities both in the quantitative and the qualitative aspects. Horizontal and vertical distribution and the aspects of demographic structure were also brought under discussion. We also analyzed the similarity degree of the gamasid mites communities from the five stands on the base of specific composition and some quantitative parameters, too. This study is part of a wider investigation dedicated to the edaphic mesofauna on the whole and conducted within BIODIVERS Research program, funded by the Romanian Ministry of Education and Scientific Research.

Cocoa crop strategies influence the community composition and abundance of predatory mites (Acari: Phytoseiidae)

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During the last few years, cocoa plants (*Theobroma cacao*) in North-West and North-East Brazil have been threatened by the cocoa bud mite *Aceria reyesi* (Nuzzaci) (Eriophyidae), which causes severe bud deformation. A study aiming to know the predatory mite communities (Phytoseiidae) occurring on cocoa plants and surrounding vegetation was conducted in 2014-2015 in some cropping areas of Bahia State. Diversity and abundance of phytoseiid species were compared between cocoa plants and non-cultivated vegetation associated to crop and between two different crop systems (shaded, the traditional system where cocoa plants are protected from the sun by a number of trees and sunny, where cocoa lacks that sun protection). Ninety-five samples were collected and 608 phytoseiid mites belonging to 27 species were extracted from plants. *Amblyseius operculatus* (142 individuals), *A. perditus* (109), *Iphiseiodes metapodalis* (79) and *Typhlodromalus aripo* (69) were the most abundant species. Predatory mites were much richer (22 species) on non-cultivated vegetation (0.88 species per sample) than on cocoa plants (14 species, 0.19 species per sample). Only nine species occurring on surrounding plants were collected on cocoa. There were no significant differences in abundance between cocoa (6.36 phytoseiids/sample) and non-cultivated plants (6.52 phytoseiids/sample). Crop strategy influences the richness and abundance of mites on non-cultivated plants. Twelve phytoseiid species were collected from cocoa plants irrespective from the crop system (shaded or sunny). Likewise, density of predatory mites on cocoa was similar on plants under sun protection (5.63 phytoseiid/sample) and on plants without protection (7.33 phytoseiids/sample). However, species richness on natural vegetation was higher in shaded areas (19 species) than in sunny areas (8 species) and predatory mites were much more abundant in shaded areas (11.3 phytoseiids/sample) than in sunny areas (3.33 phytoseiids/sample).

Study of species status and intraspecific variation of oribatid mites in oak forest ecosystems from the Basque Country and Navarra (Spain), using phylogenetic methods

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We investigated with phylogenetic methods the species status and intraspecific variation, individuals from six oak forests grouped in 10 species: (*Hermaniella dolosa*, *Platynothrus peltifer*, *Cerachipteria jugata*, *Minunthozetes semirufus*, *Xenillus tegeocranus*, *Damaeus maximus*, *Rhacaplacarus ortizi*, *Steganacarus magnus*, *Steganacarus*



magnus anomalus, and *Atropacarus wandae*). Two molecular markers, a 251 bp fragments of the nuclear gene 28S rDNA (D3) and a 477 bp fragment of the mitochondrial gene cytochrome c oxidase subunit I (COI), were used. Samples were taken along a bioclimatic gradient from Atlantic to sub-Mediterranean region. Based on phylogenetic analyses, the implications of our finding for oribatid mite identification and biogeographic comparison were discussed. Results suggested that D3 region is useful as species marker for all studied species which are not closely related, but not for closely related *S. magnus* and *S. m. anomalus* which were grouped together. While COI fragment let to differentiate this two species in two high supported separated clades. The phylogeography study showed that no species present a haplotype divergence explained by climatic region. The influence of isolation by distance (IBD), analyzed using Mantel test, showed that only in *H. dolosa* the geographic structure explained an important percentage of the variability (44.9 %), showing a grouping of haplotypes according to geographical distribution supported a strong clade differentiation in relationship with this distribution. In contrast, rest of species the isolation by distance explain a low variability of the genetic diversity (<14%), not being able to explain the high genetic divergence in individuals from the same locality, neither the fact that specimens of close geographical regions are strongly separated genetically or that very distant geographical specimens are genetically identical.

Zoogeography and phenology of *Hemipteroseius adleri* (Mesostigmata, Otopheidomenidae)

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Mites of the family Otopheidomenidae are haemolymph-sucking ectoparasites of insects. *Hemipteroseius adleri* Costa, 1968 is parasite of bugs (Heteroptera), in Europe known from red firebug *Pyrrhocoris apterus* (Linnaeus, 1758) only. *H. adleri* was described from Israel and findings are known from Poland, Lithuania, Hungary, the Czech Republic and Slovakia. Our findings of *H. adleri* from Germany, Austria and Armenia are the first records for these countries. On the basis of our extensive material we tested the phenology and vertical distribution of *Hemipteroseius adleri* in Slovakia. This work was financially supported by KEGA grant No. 059UK-4/2014.

Determination of harmful mite species (Acarina: Prostigmata) of ornamental plants, deciduous trees and shrubs of Tekirdağ –Turkey

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Plant parasitic mites species were determined from parks of Tekirdağ Province (Suleymanpasa district) in Thrace region of Turkey between 2011 and 2012. Specimens were collected at weekly intervals from various plants, including deciduous trees, conifers, ornamental trees, shrubs in parks, gardens, nurseries and green areas. The samples were taken mainly from unsprayed areas during the growing seasons. In total, 274 samples were taken belong to 47 different species of plants. Harmful mites were collected from 14 of these plant species. Mites were extracted under the stereomicroscope and preserved in 70% alcohol. They were cleared in lactophenol solution and mounted in Hoyer's medium. The slides were dried (for 2–4 weeks) at 35°C. During the study eight prostigmatic mite species (Acari: Prostigmata) belonging to 5 genera and 2 families were identified. From Tetranychidae two species were identified as *Tetranychus urticae* Koch, *Panonychus ulmi* Koch. 3 species belong to *Cenopalpus* genera were identified, which were *Cenopalpus spinosus* Donnadieu, *Cenopalpus bakeri* Dosse and *Cenopalpus pennasitesus* Wainstein. *Pentamerismus oregonensis* McGregor, *P. taxi* Haller and *Brevipalpus lewisi* McGregor were other Tenuipalpides. *T. urticae* was obtained from 8 different plant species and found as the most common species with 51,03%. It was followed by *C. bakeri* with 32,41%. According to the survey results *Pyracantha coccinea* was the most favourable host with 42 specimens, while *Rosa gallica* was second with 25 individuals.

New and uncommon species of Oppiidae (Acari, Oribatida) recorded in Romania

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The family Oppiidae is one of the largest and diverse families of oribatid mites with more than 1000 known species that populate various edaphic habitats across the world. To date, in Romanian fauna about 90 oppiid species were registered, 22 of them being described as new species in the last two decades by N. Vasiliu, O. Ivan, S. Mahunka and L. Mahunka-Papp. This list comprises both frequent, eurytopic species and some uncommon, rarely collected, possible stenotopic ones. Of the second category, five recently recorded species are included in this study, as follows: *Multioppia (M.) perfecta* Mahunka et Topercer, 1983, *Ramusella sengbuschi tokyoensis* (Aoki, 1974), *Ramusella alejnicovae* (Krivolutsky et Gatilova, 1974), *Rhinoppia nasuta* (Moritz, 1965) and *Lauroppia iranica* Akrami et Subias, 2008. The last three species are mentioned for the first time on Romanian territory. For each species a concise redescription and illustration is provided, compared with original description or subsequent ones, if case. Also, data regarding the type of habitat, occurrence in sampling areas, and world distribution of each species are analyzed. In addition, the status of *Multioppia (Hammeroppia) insolita* Ivan et Vasiliu, 1999 is discussed, based on recently collected specimens of this rare species. According to Subias, 2004 (updated 2016) it is considered as possible synonym of *M. (H.) wilsoni laniseta* Moritz, 1966. Comparative analysis of some morphological details observed in *M. (H.) insolita* and mentioned in literature for the close related taxa (*M. (H.) wilsoni wilsoni* Aoki, 1964; *M. (H.) wilsoni hungarica* Mahunka, 1983; *M. (H.) wilsoni laniseta* Moritz, 1966) provides reasons to deem *insolita* as valid species.

Abundance of the phytoseiid (Acari: Mesostigmata) mites in citrus ecosystems in Adana Province, Turkey

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Species of the mite family Phytoseiidae (Acari: Mesostigmata) are of great importance in terms of regulating not only pest mite populations but also small soft bodied insects such as thrips and whiteflies. Adana is one of the most important citrus production area of Turkey. In this study, a total of 16 species belonging to 6 genus and 2 subgenus were found during the surveys that carried out between the years 2010 and 2016. Among them, *Amblyseius andersoni* (Chant), *A. swirskii* Athias-Henriot, *Euseius finlandicus* (Oudemans), *E. scutalis* (Athias-Henriot), *E. stipulatus* (Athias-Henriot), *Phytoseius finitimus* Ribaga, *Typhlodromus (Anthoseius) invectus* Chant, *T. (A.) recki* Wainstein, *Typhlodromus (Typhlodromus) athiasae* Porath & Swirski, *T. (T.) cotoneastri* Wainstein and *T. (T.) tiliae* Oudemans were directly collected from citrus (*Citrus* spp.) leaves. *Proprioseiopsis messor* (Wainstein), *Ph. finitimus*, *Neoseiulus barkeri* Hughes, *N. bicaudus* (Wainstein), *N. sekeroglui* Döker & Stathakis and *N. marginatus* (Wainstein) were found on various weeds that follows *Anchusa* sp. (Boraginaceae), *Arundo donax* L., *Avena sterilis* L., *Sorghum halepense* (L.) (Poaceae), *Malva* sp. (Malvaceae), *Pallenis spinosa* (L.) CASS. (Asteraceae) and *Rubus* sp. (Rosaceae), in citrus agroecosystems. *A. swirskii* (36%), *E. scutalis* (18%) and *T. (T.) athiasae* (10%) were determined to be the most common species in citrus ecosystems in Adana, Turkey.

Plant parasitic mite species (Acarina: Prostigmata) of pome fruit trees of Tekirdag-Turkey

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This survey was conducted to determine plant parasitic mite species on pome fruit trees of Tekirdag Province in Thrace region of Turkey. In total 189 samples were collected at weekly intervals from apple, pear, quince and



medlar trees during the growing season and 117 samples were infested with mites (63.49 %). To detect the presence of phytophagous mites, the sampled leaves were examined in the laboratory, under a stereomicroscope. They were cleared in lactophenol solution and mounted in Hoyer's medium. As a result of survey nine plant parasitic mite species were identified belong to Tetranychidae and Tenuipalpidae families. On apples, *Tetranychus urticae* (Koch) was found the most common mite species (57.32 %), and it was followed by *Amphitetranynchus viennensis* (Zacher) (23.13 %) and *Panonychus ulmi* (Koch) (11.28 %). Belonging to Tenuipalpidae, *Cenopalpus pulcher* (Canestrini & Fanzago, 1876), *C. lanceolatisetae* (Attiah 1956) and *Brevipalpus lewisi* McGregor were also found from apple trees. According to the results *C. pulcher* was found most common species with 84.97 % on quince, whereas *T. urticae* was most abundant on pears (93.61 %). Medlar trees were infested only by *C. pulcher*. Also *Malus communis* was the most preferred host by 895 specimen of nine phytophagous mite species.

Diversity and abundance of Phytoseiidae (Acari: Mesostigmata) on horse chestnut (*Aesculus hippocastanum* L.) in Greece and the Czech Republic

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Horse chestnut, *Aesculus hippocastanum* L. (Sapindaceae), is a large deciduous tree native to small area in the Pindus Mountains mixed forests and Balkan mixed forests of South East Europe. It was introduced to most countries of Europe for ornamental purposes mainly. The aim of the present study was to assess the occurrence, species composition and population densities of phytoseiid mites on *A. hippocastanum* in country where this tree species is autochthonous and compare them with Central Europe. Leaf samples were collected in cities Orestiada, Greece and České Budějovice, Czech Republic in September 2015 and 2013, respectively. Thirty compound leaves were randomly taken from tree branches up to 2.5 m above ground in both localities. Mites were collected by washing the leaves in ethanol, mounted in lactic acid and identified. A total of 441 specimens of phytoseiid mites belonging to six species (*Euseius finlandicus*, *Neoseiulella tiliarum*, *Kampimodromus aberrans*, *Paraseiulus talbii*, *Phytoseius macropilis* and *Typhlodromus (Typhlodromus) pyri*) were collected. *Euseius finlandicus* was the predominant species both in České Budějovice (96.8%) and Orestiada (48.4%) where, however, competed with *K. aberrans* (42.9%). Significantly higher density of Phytoseiidae was found in České Budějovice.

Distribution of *Brevipalpus papayensis* Baker (Acari: Tenuipalpidae) in different host plants and locations in the State of São Paulo

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Some mite species of the genus *Brevipalpus* are considered pests of economic importance for several agricultural crops such as citrus and coffee. They are associated with the transmission of viruses [e.g. *Citrus leprosis virus* (CiLV), *Coffee ringspot virus* (CoRSV)]. Recent studies indicated that *Brevipalpus phoenicis*, considered the main vector of CiLV and CoRSV in Brazil, was a complex of species. *Brevipalpus papayensis* Baker is one of the most important mites of this species complex; however, there is still little information available on its host plants and distribution in Brazil. The objective of this research was to evaluate the incidence and the distribution of *B. papayensis* mites in different host plants and regions in the State of São Paulo (SP). We examined *Brevipalpus* mites from the mite reference collection of the Instituto Biológico, in Campinas City, SP, and also from plant samples (e.g. branches and leaves), especially of coffee and citrus, collected from several localities in the State of

São Paulo. Mites of this species were found on coffee plants in the municipalities of Assis, Atibaia, Campinas, Cordeirópolis, Itupeva, Monte Alegre do Sul and São Paulo. On citrus (lemon, tangerine, sweet oranges), in the municipalities of Amparo, Atibaia, Monte Alegre do Sul, Registro, São Paulo and Tapiraí. On *Musa* sp. (Musaceae) and *Ligustrum* sp. (Oleaceae), in Campinas, on *Punica granatum* (Lythraceae) in Jeriquara, on *Fortunella margarita* (Rutaceae) in Monte Alegre do Sul and on *Malpighia emarginata* (Malpighiaceae) in Itirapuã and São Paulo. On citrus, this species were found in higher frequencies in the regions of lower temperatures, considering all the evaluated places.

Preliminary results on mite fauna associated to plants in gardens and green areas of Valencia, Spain

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Green areas are important agents for society development, because of their ecological and environmental effects. Moreover, they have characteristics as a cultural reference and entertainment centers. Currently, new strategies for pest management, which imply the use of natural enemies, are being carried out in order to decrease environmental impact of the use of pesticides. For this reason, it is a requirement to know the fauna of phytophagous and beneficial insects and mites occurring on vegetation. Knowledge of mite species from these environments in Valencia is still very scarce. In this study, plant material was collected once a week during May-June 2015. Samples were collected from 4 different green area locations: Ayora Garden and Real Gardens and two points of Turia Gardens. We sampled 62 plant species belonging to 37 plant families, which included trees, herbaceous plants and shrubs. Mites were extracted using Berlese funnels. A total of 3030 specimens from 29 species belonging to 11 families were identified. The most common and abundant families were Phytoseiidae, Tetranychidae, Tydeidae and Tenuipalpidae. Phytoseiid mites with nine species were the most diverse, while Tetranychid mites with 1988 individuals were the most abundant group. *Euseius stipulatus* (Athias-Henriot) (347 individuals) was the dominant and widely distributed predatory mite, being collected on 40 plant species belonging to 28 families. *Tetranychus ludeni* Zacher (1348 individuals) was the most abundant phytophagous mite. *Tydeus caudatus* (Duges) was the predominant Tydeid mite (75,1% of 438 individuals). Within the Tenuipalpidae, *Brevipalpus ferraguti* Ochoa & Beard was the most abundant, mostly on the Myoporaceae *Myoporum laetum*.

Diversity of mites on *Macrothele calpeiana* (Araneae: Hexathelidae)

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Worldwide only a few mygalomorph spiders are known to host mites on their bodies. The mites, all belonging to the family Laelapidae, seem to have developed a specific interaction with their chelicerate host, although nothing is known yet of the nature of this unique interaction. While a diverse number of Australasian and African spiders carry species of *Ljunghia* and *Hypoaspis*, in Europe only one species, the big cork funnel spider, *Macrothele calpeiana* hosts a species of another Laelapidae, *Androlaelaps pilosus* Baker. *A. pilosus* was described in 1991 from a female *Macrothele* collected in the Andalusian town of Facinas, in the Cadiz province. At the time of the description of the new laelapid, *M. calpeiana* was considered a species of spider at risk of extinction and seriously protected. The status, however, has changed over the last 10 years as the spider became highly abundant and not only over Andalucía, but covering a much larger territory over the northern Mediterranean coast of Spain. In a recent survey of invertebrates carried out within jurisdiction of the Barbate municipality 2 female individuals of *M. calpeiana* were collected. The new location is separated of Facinas by approximately 10 Km of hills and valleys. Of the two specimens, only the larger spider carried 7 mites. The mites were located in the dorsal fovea of the spider, they were extracted with a brush, fixed and mounted. Interestingly, preliminary identification of the mites of the new collection revealed a different morphospecies of *Androlaelaps*.



Damage, population dynamics and spatial distribution of *Brevipalpus ferraguti* Ochoa & Beard (Acari: Tenuipalpidae) on *Myoporum laetum* (Myoporaceae)

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Brevipalpus mites (Acari: Tenuipalpidae) are of great economic importance due to their role as virus vectors in economic plants. The taxonomy of the genus is currently being revised and *B. ferraguti* Ochoa & Beard occurring on some ornamental plants in Valencia, Spain, has been recently described. In this work, information on mite damage, population dynamics and spatial distribution on *Myoporum laetum* G. Forst (Myoporaceae) leaves is provided by the first time. The flat mite produces important damage on *Myoporum* plants, commonly used as hedges in many gardens and city streets. Leaves become discoloured and bronze-coloured and then they dry and fall. Mite populations were higher in summer (216 mites/leaf), decrease in autumn and winter (8 mites/leaf) and drop below 2 mites/leaf at the beginning of spring. Mites showed a highly aggregated distribution on the leaves and on both upper adaxial and lower abaxial leaf surfaces. Values of index b (Taylor's power law) were somewhat higher for eggs ($b = 1.48$) than for mobile immature ($b = 1.40$) and adult females ($b = 1.34$). Eggs were laid by females along midribs, irrespective of the leaf surface considered. Mobile immature preferred the lower and the proximal part of leaves for living, while adult females were more abundant on the distal part of upper surface and on the proximal part of lower surface.

Diversity of soil-dwelling mites (Acari: Mesostigmata), in organic and conventional vineyards in Valencian Community, Spain

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Diversity and abundance of soil mesofauna (Acari: Mesostigmata) have been studied in El Poble Nou de Benitatxell (Alicante province, Spain) in 2014-2015. In this study, Mesostigmata mites have been analyzed by comparing four seasons (autumn, winter, spring and summer), three crop systems (organic vineyards, conventional vineyards, natural environment) and three different sites within each plot (border, between rows and between vines). Thirty-five species and eleven families were identified. Species from the families Laelapidae, Pachylaelapidae, Phytoseiidae and Rhodacaridae were the most abundant, accounting for 92% of mites captured. The results shown that mite abundance was higher in autumn and winter, less in the natural environment and similar in the three sampled sites of the plots. Diversity measured by Shannon indices was lower in spring, less in the natural environment and largest between the vines and in the border of the plots. Relationships among the most abundant mite species and factors studied have been detected.

Mite and collembola assemblages influence variously litter decomposition rate of different litter types

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Many studies have investigated whether microbiota has been adapted to decompose a given litter type but we have limited information about the specific role of mites and collembolans in litter decaying processes. In this experiment, mite and collembola assemblages were interchanged among three different litter types (Scotch pine, Turkey oak and black locust litter) to investigate functional redundancy of soil-dwelling microarthropods in litter decaying processes. The litter samples were defaunated with heating, then reinoculated with their original microbiota and stored in microcosms. Microarthropods were extracted alive from intact litter samples into these defaunated litter substrates: into similar ('home') and different ('foreign') litter type. The first hypothesis was that total densities of mites and collembolans would be lower in 'foreign' litter than in 'home' litter. The second hypothesis was that litter with foreign mites and collembolans would be decomposed slower than with native microarthropods. At the end of the incubation times (3 and 12 months), microarthropods were extracted from the microcosms and density of collembolans, oribatid and other mites were recorded. Litter decomposition rate was estimated with dry mass loss. Total density of microarthropods depended on litter type irrespective of the origin of animals. Litter mass loss values differed in the three litter types. The origin of microarthropods had significant effect on pine litter mass loss. Microarthropod density influenced decomposition of oak litter. For black locust litter, neither the origin nor the density of animals influenced the decomposition rate of litter. Litter quality may have determined the different patterns of decaying. Microarthropods may enhance litter decomposition stronger in pine litter than in litter types with higher quality.

An experimental design to estimate the impact of drought stressed plants on *Tetranychus urticae* fitness parameters

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Global warming will increase the risk of drought in dry regions and bring more drought periods. Even in regions that may not see changes in precipitation, warmer temperatures can increase evaporation and water demands, resulting in a greater pressure on water supplies. Consequences of drought stress will directly affect plant tissues and indirectly the interaction between plants and their pests. We designed an experimental set-up to investigate the effect of water stressed plants on fitness parameters of *Tetranychus urticae* reared on beans, *Phaseolus vulgaris*. Plants grown in 2.0 litter pots in standard compost, were linked to an automated drip irrigation system using soil moisture sensors which provide feedback into a computer system. Plants were imposed to two water regimes. The relative humidity to soil was maintained in the range of 45-55% for the plants in control regime and of 8-13% for severely stressed plants. The stress intensity was assessed by measuring the daily stomatal conductance of 10 plants in each treatment. To limit maternal effects, mites were reared for one generation on either stressed or fully watered plants before measurements. To assess the effect of drought stress on mites reared at 25°C, the following parameters were calculated: fecundity, generation time and sex ratio. Artificial infestation of leaves with a fixed number (10 per leaf) of adults females (of the same known age) were placed on the lower surface of the cotyledons leaves. Mites were confined in a delimited leaf surface (3 cm²) by using lanoline rings. The number of eggs per females was counted; the time of development to adulthood and the sex ratio were also estimated. The same protocol was applied for *T. urticae* having been exposed to drought and non-drought stressed bean plants. The experimental set-up here described can be adapted to estimate the effect of drought stress not only on other mite species but also to study tritrophic interactions between plants /phytophagous mites and phytoseiid mites.

The relationship between female body size and egg number and size of *Acrotrititia ardua* (Koch, 1841) (Acari, Oribatida, Euphthiracaridae)

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Oribatid mites in various habitats account for the biggest part of microarthropods. Until now, about ten thousand of oribatid mite species have been described. Species richness and diversity of oribatid mites make a big contribution to heterogeneity in different microhabitats. Oribatids are iteroparous and mostly have low metabolic rates, slow development and low fecundity. The main aim of this study is to examine the relationship between female body size and egg number and size of *Acrotrititia ardua* (Koch, 1841). The materials of this study were collected from Erzincan, Turkey during October 2014 – March 2016 and extracted by using Berlese-Tullgren apparatus from soil, litter and moss samples. The relationship between female body size and egg number and size were statistically evaluated using Spearman's rho correlation in SPSS pocket programme. $p < 0, 05$ was considered significant. According to Spearman's rho correlation test, a significant correlation was observed between female notogastral length and egg number ($p = 0,001$, $R_s : 0.312$). Similarly, relationship between female notogastral height and egg number ($p = 0,002$, $R_s : 0.294$); notogastral height and egg width ($p = 0,001$, $R_s : 0.320$) was statistically significant. It is concluded that there is a relationship between female body size and egg number and size of *Acrotrititia ardua* (Koch, 1841). Egg size and number may be depending on the notogastral carrying capacity.

The first case of mite-on-mite hyperparasitism?

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We present first findings of parasitic interactions between mites and host gryllacridid crickets, and document both multiple parasitism and perhaps the first known instance of hyperparasitism among the mites themselves – an acarine case of 'fleas having lesser fleas'. Mites of three unrelated major taxa were found on adult male *Chauliogryllacris* sp. from northeastern Australia. They included three larvae of an unidentified Erythraeidae (Prostigmata: Parasitengona) on the host's wings, nine adult females and one protonymph of an undescribed genus of katydiseiine Otopheidomenidae (Mesostigmata: Gamasina) mostly on wings (one female on host's thorax), and numerous larval females and adult males of an undescribed species of Podapolipidae (Prostigmata: Heterostigmata) on thoracic surfaces of the host. With their cheliceral digits cutting through the cricket's cuticle, the gamasines were clearly parasitic on the *Chauliogryllacris*, which cannot be said about the podapolipids – only one of about fifty had its cheliceral stylets inserted in the insect's cuticle. The larval podapolipid females were also found attached to all mature female gamasine mites, a teneral female and a protonymph being free from them. Intriguingly, their stylets were clearly embedded through the mite's cuticle – the stylet tips were broken off when removed from the gamasines. Yet, whether they were feeding remains uncertain, with no idiosomatic distention evident. Although the cricket is a 'real' host to the gamasine mite (which is nymphiparous, like some vertebrate parasites), is this also true for the podapolipid, whose adult females were not found?. Nine of ten of gamasines occurred on the cricket's wing surfaces, while podapolipids were concentrated around wing bases – for intercepting gamasines? Were some larval female podapolipids ever found on insects, on which they will not complete their life cycle by molting to adults? Can some podapolipids have phoretic hosts, the carrier being their host-meeting environment? These and other intriguing questions persist.

Distribution of Macrochelidae mites in peripheral and central portions of cattle dung

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Macrochelidae mites colonize cattle dung by phoresy on coprophagous beetles and soil fauna. Some Macroche-lidae predate eggs and larvae of the haematophagous flies *Haematobia irritans* and *Stomoxys calcitrans*. The current abstract presents distribution data of Macrochelidae mites in cattle dung collected from February to August in farms located in four municipalities of the state of São Paulo, south-eastern Brazil. Seven pats were collected from each site and each one was divided into peripheral and central portions, which were separately placed in labelled plastic bags. At the laboratory, cattle dung samples were placed in the Berlese-Tullgren apparatus during three days to recover the acarids. Juveniles and adult males and females were counted. Adult females were used to identify the species. Each female was dissected by separating the ventral from the dorsal and posterior plates to assemble slides in Hoyer medium. April has yielded the greater number of mites in all farms. The peripheral portions presented a similar population profile during all the months, characterized by a majority of juvenile mites, followed by females and a minority of males. The central portion differed from this profile in two occasions only, provided no males were found in February, while in July only females were counted. Besides that, the proportion of mites in the peripheral and central portions was similar throughout the experimental period, yielding, respec-tively, 58% and 61% of juvenile forms; 26% and 24% of females; 16% and 15% of males. The different population profiles between peripheral and central portions may reflect different types of colonization, with the peripheral portion relying upon soil fauna and the central portion depending upon phoresy on dung beetles. Nine Macroche-lidae species were identified in the samples: *Macrocheles merdarius*, *Macrocheles robustulus*, *Macrocheles sub-badius*, *Macrocheles peniculatus*, *Macrocheles glaber*, *Macrocheles roquensis*, *Macrocheles novaodessensis*, *Glyphtholaspis confusa* and *Glyphtholaspis americana*.

“Salivary secretions” of Eriophyoids (Acari: Eriophyoidea): further knowledge on the eliciting procedures

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Based on the interactions with the host plant, Eriophyoidea can be classified in a) vagrants, b) refuge-seeking and c) gall-making mites. The tiny Eriophyoid mouthparts rarely cause mechanical injuries to the plant cells. The saliva introduced when piercing plays a role in the digestion of cell sap or in the bio-chemistry balance of plant cells with possible histological and physiological effects. The composition of the watery saliva of Eriophyoidea and the effects of its compounds on plant metabolic pathways are very poorly known. Bioassays were aimed at ascer-taining the optimal conditions (storing temperature of mites, kind and density of elicitors) for stimulating salivary secretions. Bioassays were performed on *Aceria caulobia* (Nalepa), a gall-making mite on stems of *Suaeda vera* Gmelin (Chenopodiaceae). The mites were assayed for the secretion by means of 1) oil for microscopy (135 cs) after storing galls at 4±1°C, 23±1°C and outdoor temperature for 24, 48, 72 and 96 hours; 2) oils for immersion objectives with a viscosity of 135, 150, 1250 and 21000 cs; 3) vaseline oil mixed with oil for immersion objectives, toluene or xylene at different concentrations; 4) water solutions of some neurotransmitters (acetylcholine and serotonin). The standard assay revealed secretion through microscope observations of the optical differences of watery discharged droplets coming out at the mouthpart tip when the mites were dipped in oil. The eliciting of neurotransmitters in water was verified by an auxin-like activity assay upon a differential wheat coleoptile growth of the collected watery secretion. Usually, it was observed that more mites secreted saliva when they came from galls stored at cold in respect to those from galls stored at outdoor temperature and at 23±1°C. More mites were significantly elicited by 135 cs immersion oil. The mixture between immersion and vaseline oils did not induce more mites secreting saliva than the pure immersion oil. Toluene in vaseline oil induced saliva secretion in a very



low number of mites. This was also observed for xylene in vaseline oil, though its elicitation effect appeared to be stronger and dependent on the percentage of the xylene. The solution obtained by mites treated with neurotransmitters produced a higher growth of wheat coleoptile than the pure solution suggesting the salivary elicitation of the mites by these chemicals.

Preliminary assay on the survival of Eriophyoidea at stress environmental conditions potentially related to air-dispersal

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Dispersal of Eriophyid Mites is relevant for intraplant migration and colonization of further plants. Most literature supports a long-distance dispersal of the mites by means of wind, even though it has a scarce efficiency. Eriophyid Mites should be pushed in the atmosphere from the host plant surfaces by the upward motion of the warmer air. Then, they might be included in water vapor (e.g. clouds) where they might be protected against body dehydration and direct sun rays, but where they might find low temperature, lower oxygen concentration and no food. A considerable resistance of the mites to these stressing environmental conditions is supposed and it has only been occasionally ascertained. The aim of this trial was to assess the survival of the Eriophyid Mites in absence of air and food, and at two levels of temperature. The assays were carried out on live mites dipped into two different mixtures (as microenvironments): 1) vaseline oil (always used in previous assays); 2) water solution of Tween 80 (0.2%) and cycloheximide (50 mg/l). The assays were performed at 5 ± 1 and 25 ± 1 °C. The survival of the mites was assessed almost every day (at 5 ± 1 °C) or every week (25 ± 1 °C). The following species were subjected to the assay: *Aceria caulobia* (Nalepa), from stem galls on *Suaeda vera* Gmel., *Phytoptus avellanae* Nalepa, from bud galls on hazelnut, *Cecidophyopsis hendersoni* (Keifer), vagrant on leaves of *Yucca* sp., *Colomerus vitis* (Pagenstecher) from buds and leaves of grapevine. As expected, the survival of mites was shorter at a 25 ± 1 °C than at 5 ± 1 °C in both microenvironments for all species. The survival was longer in water solution (up to 6-7 weeks) than in Vaseline oil (3-5 weeks) at the lower temperature for all species. The survival trend was quite similar for all assayed species in water solution at 5 ± 1 °C.

Genetics and Evolutionary Acarology

Genetic diversity in worldwide collections of *Tetranychus urticae* (Acari: Tetranychidae)

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The spider mite *Tetranychus urticae* Koch (Acari: Tetranychidae) is a cosmopolitan and extremely polyphagous agricultural pest. Over the last years a large number of studies have deployed molecular DNA markers to investigate the geographical distribution of the genetic diversity of the species. We undertook a phylogeographic study by exploring the mitochondrial diversity of *T. urticae* from a large worldwide sampling effort: 51 collections from 27 countries around the world. Genetic diversity of *T. urticae* was studied by analysing sequence data of a 700 bp fragment of mitochondrial cytochrome oxidase I (COI) gene. Samples of red and green form of *T. urticae* originating from different host plant species (cultivated and non-cultivated) were included in this study. The phylogenetic analysis of a total of 110 individuals revealed two clearly separated lineages (>5% sequence divergence) containing collections of both colour forms and of different host plants. However, one clade displayed low diversity and

comprised samples originating mainly from the Mediterranean basin. The second clade consists of samples from all continents (both North and South hemispheres) and displayed much higher variability. *T. urticae* from some Mediterranean countries (Greece, Cyprus and Turkey) are present in both lineages and in some cases, individuals sampled from a single location fell into two different lineages. The comprehensive study of *T. urticae* populations undertaken here from a wide geographic range, disclosed the extensive nucleotide sequence diversity of COI in *T. urticae* and confirmed the substantial genetic polymorphism of this species.

Genome analysis of *Cheyletus eruditus* (Trombidiformes: Cheyletidae)

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Cheyletus eruditus, also known as the cannibal or hunting mite, is a predatory mite that is being used in biological control of stored food mites as well as of snake mites. The family Cheyletidae is also the sister taxon to the family Demodicidae, the hair follicle mites. While members of the Cheyletidae are free-living mites, members of the Demodicidae are associated with a host. Many follicle mites of animals have been categorised as ectoparasitic mites, although detailed studies are often missing to make such an assertion. The fact that most humans with a healthy skin do carry follicle mites, which they obtained as babies from their mothers provides these species with a unique position. These mites are dependent on a host like parasitic mites are, but since they are vertically transmitted from mother to offspring, they no longer depend on a free-living stage where they have to find a new host like an ectoparasitic species. To investigate the impact of such a life history change on the genome structure and content, whole genome sequencing of *C. eruditus* has been undertaken using a combination of two next generation sequencing techniques, single molecule real time sequencing (SMRT) from Pacific Biosciences and HiSeq from Illumina. The SMRT method provides very long sequencing reads that facilitate greatly the genome assembly while the HiSeq method provides very high sequence coverage to minimise the error rate.

Promoting adaptability of *Amblyseius swirskii* predatory mites to tomato crop

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Amblyseius swirskii Athias-Henriot (Acari: Phytoseiidae) is a predatory mite very effective for controlling whiteflies and thrips in a wide range of protected crops. However, on tomato (*Solanum lycopersicum*) its survival and efficacy as biological control agent is hindered, most probably due to lack of adaptation to the plant's defenses, such as the tomato trichomes and their exudates. Our main goal is to select for *A. swirskii* strains better adapted to tomato crop by 1) laboratory selection of *A. swirskii* for better performance on tomato plants, (2) phenotypic characterization of selected strains/colonies assessing their performance as biological control agents, and (3) applying genetic, genomic and biochemical approaches to investigate the mechanisms regulating the adaptation. For this, *A. swirskii* will be released on tomato plants for multiple generations, adding eggs of *Ephestia kuehniella* and pollen as food source. Population density and life history parameters (e.g. fecundity, survival) will be assessed regularly, at fixed time intervals. Then, the adapted strain will be characterized phenotypically (morphological characters, life history traits) and molecularly, by quantifying the genetic variation of loci identified with the transcriptomic analysis and associated with the performance on tomato. Finally, the selected strain of *A. swirskii* will be evaluated under semi-field experiments and new protocols for IPM in tomato based on the use of *A. swirskii* will be developed. In parallel to this adaptation experiment, the molecular mechanisms of the harmful effect of tomato on *A. swirskii* will be characterized. For this, the transcriptomic responses of *A. swirskii* to pepper, a common host plant of *A. swirskii*, and tomato will be compared in order to identify the key metabolic pathways that are activated due to the harmful effect of tomato on *A. swirskii*.



EST (expressed sequence tag) analysis for finding of enzyme origin in *Nanhermannia* (Nanhermanniidae: Oribatida)

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There are many papers about food habits of oribatid mites studied as a decomposer by morphological and ecological view (e.g. Smrž et al, 2015). Siepel and de Reuiter-Dijkman (1993) reports seven types of guilds in oribatid mites based on several patterns of biochemical enzyme activities, cellulase (digestive enzyme of cellulose, main component of plant cell wall), chitinase (chitine, main component of fungal cell wall) and trehalase (trehalose, main component of cytoplasm). Our purpose was an exhaustive investigation on gene expression of *Nanhermannia verna*, as a model of oribatid mites. The data set was neither taken from isolated gut cell of mites nor used isolated microbes, however, the data set could be based on several expanded studies (e.g. in situ hybridization). The database of EST analysis was established by cDNA library and a massive sequencer. The 589,151 reading 56.4M bases was determined by Ion 318 chip, Ion PGM 200 sequencing Kit (Life Technologies) with Ion Torrent PGM (Life Technologies). De novo assembly was carried out by CLC genomic workbench (CLC) and obtained 4,849 contigs. These contigs were analyzed free soft, blastX and Blast2go. Finally, expressed eleven cellulase genes were detected and was suspected to originated from Arthropoda (36%), Protista (9%) and Bacteria (55%). Similarly, other two expressed genes were suspected these origin as that gene 36 expressed trehalase gene from Arthropoda (8%), other organisms of Animalia (2%), Fungi (8%) and Bacteria (79%), 14 expressed chitinase gene from Arthropoda (79%), and Bacteria (21%). Actually, so many origins of expressed gene in such tiny oribatid mites. For studies of oribatid mite function as a decomposer, we would like to take next step based on these results of gene expression.

Biological Control and Integrated Pest Management

The effectiveness of *Amblyseius swirskii* (Mesostigmata: Phytoseiidae) to suppress *Polyphagotarsonemus latus* (Prostigmata: Tarsonemidae) on tea plant

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The yellow tea mite, *Polyphagotarsonemus latus* (Banks) (Prostigmata: Tarsonemidae) is a serious pest of a variety of agricultural crops worldwide. Recently, this mite has been observed to cause damage to leaves of tea plants in Rize province. *Amblyseius swirskii* (Athias-Henriot) (Mesostigmata: Phytoseiidae) has been identified as a potential predator of *P. latus*. In the study, the effectiveness of *A. swirskii* to control *P. latus* population was assessed on Tuglali-10 tea cultivar seedlings at 1:10 and 1:20 predator:prey release ratios per plant in Rize. Completely randomized plot design with four different treatments including the sprayed, unsprayed control and release plots was set up. During the experiment, the release of the predatory mite was not repeated. The mite populations were evaluated by sampling weekly young leaves from the top of the plant from 4 August to 29 September 2014. The lowest *P. latus* population occurred in 1:10 predator:prey ratio, followed by 1:20 predator:prey ratio, sprayed control and unsprayed control plot. These results showed that *A. swirskii* is effective in reducing *P. latus* densities on tea seedling. However, further research is needed to determine the more precise release rate and frequency in controlling of *P. latus* population.

The prey-stage preferences of *Neoseiulus californicus* (Mesostigmata: Phytoseiidae) to *Tetranychus urticae* (Prostigmata: Tetranychidae)

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Two-spotted spider mite, *Tetranychus urticae* Koch (Prostigmata: Tetranychidae) is a phytophagous spider mite that feeds on a large variety of plant families worldwide. *Neoseiulus californicus* (McGregor) (Mesostigmata: Phytoseiidae) is a promising agent for successful *T. urticae* control. In this study, the prey-stage preferences of *N. californicus* with *T. urticae* as the host at different prey egg: nymph ratios (1:1, 1:2, 2:1) were evaluated under laboratory conditions. Experiments were performed using 2 cm diameter bean leaf discs at 25°C ± 1, 65 ± 5% R.H. and a photoperiod of 16L:8D (Light: Dark). Gravid adult females of *N. californicus* were held without food for 24 h before tests. Each female was then placed singly onto each leaf disc together with a 1:1, 1:2 or 2:1 ratios of *T. urticae* egg (0-24 hours old): nymph (1-2 days old) (30 total prey each disc). Each treatment was replicated 20 times. The numbers of each prey-stage consumed were counted after 24 h of feeding. The results showed that *N. californicus* did not show a preference between egg and nymph stages of *T. urticae*.

Relative toxicity of pesticides on *Chrysoperla externa* (Neuroptera: Chrysopidae) and *Brevipalpus yothersi* (Acari: Tenuipalpidae)

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Mites of the genus *Brevipalpus* are considered pests of economic importance for several agricultural crops in Brazil. In coffee, they are associated with the transmission of *Coffee ringspot virus* (CoRSV). An important group of natural enemies of arthropod pests in coffee are the lacewings (e.g. *Chrysoperla externa*, Neuroptera: Chrysopidae), which play an important role as population regulators of several pest species, including phytophagous mites in this crop. The objective of the study was to evaluate and compare the toxicity of several pesticides (registered for use in coffee in Brazil) on *Brevipalpus yothersi* and *C. externa*, under laboratory conditions, in order to get basic information for the establishment of an integrated pest management program in coffee. The pesticides (concentrations in mg of a.i./L) evaluated were: spiroticlofen (120), fenprothrin (300), cyflumetofen (80), fenpyroximate (100), sulphur (1000), diafenthiuron (1000) and abamectin (6.66). The pesticides were applied using Potter Spray tower on the second instar larvae of *C. externa*. In the case of *B. yothersi*, the pesticides were applied on adult mites or eggs (only spiroticlofen). The mortality was assessed 72 hours after treatment for the active stages of *C. externa* and *B. yothersi*. For *Brevipalpus* eggs, the evaluations were carried out daily for a period of 14 days. The *C. externa* larvae were tolerant to most of the treatments, with mortalities equal to or less than 10%, except for fenprothrin, which caused a mortality rate of 70%. *Brevipalpus* mites were more susceptible to the pesticides, presenting mortalities of 76% to sulphur and higher than 90% to the remaining pesticides. The results indicate that *C. externa* presents good potential for use in mite management programs in coffee in Brazil.

Response of the Poultry Red Mite (*Dermanyssus gallinae*) to changing VOCs emitted by its host fed with additive repellents.

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The Poultry Red Mite (PRM), *Dermanyssus gallinae*, is a bloodsucking nidicolous ectoparasite parasitizing birds and is of economic importance in the worldwide poultry industry. Because of its large nidicolous life habits (spend-



ing most of its life off host), it is hard to be efficiently controlled using conventionally sprayed pesticides. Among other alternative control methods, trying to make the host repellent for mites by adding repellent substances in hen food represents a promising challenge. It is yet unknown whether repellent compounds may be modified or metabolized after ingestion by hens, and to what extent these compounds could then occur in hen volatile emissions after ingestion. Our study aims at evaluating how hen-emitted volatile organic compounds (VOCs) may be modified by ingestion of some repellent plant based additive, and then to examine the effect of emitted VOCs on PRM interaction with host. Two complementary approaches were designed for this study: comparing blends of VOCs emitted by hens (odours) and their droppings before and after ingestion of the food additive, and characterizing the response of PRM to these changing odours (both electrophysiological and behavioural responses). Preliminary results showed that hen odours are effectively modified by the ingestion of a cocktail of plant based additive.

Influence of the Grape erineum strain of *Colomerus vitis* (Acari: Eriophyidae) on the development of some grapevine cultivars of West and South Iran

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Experiments were aimed at studying the influence of the Grape Erineum strain of *Colomerus vitis* (GEM) (Acari: Eriophyidae) on some plant responses of local grapevine cultivars and the possible interactions between mite densities and cultivars. Five grape cultivars (Shahani, Sahebi Uroomie, Khalili Bovanat, Rishbaba, Sezdang Ghalat) were infested by GEM applying five population densities of the mite. The relative content of leaf chlorophyll, the internode and cane length, the leaf surface and weight, the number and size of the erineae, and the percentage of leaves with erineae were detected. Mite density on leaves and in buds was assessed, too. The relative content of chlorophyll in infested leaves was reducing with the increase of mite density. It was highly significant at the two higher mite densities for Khalili Bovanat, Rishbaba and Sezdang Ghalat; Shahani and Sahebi Uroomie leaves appeared to be less affected by mite infestation. The highest mite density showed a highly significant correlation with the weight (positive correlation) and size (negative correlation) of the leaves; leaves of Sahebi Uroomie appeared to be less affected. No differences were observed on the internode length within each cultivar, whereas the most infested plants produced shorter canes and their lengths appeared to have a highly negative and significant correlation with the highest mite density. Canes of Khalili Bovanat and Sahebi Uroomie were the shortest and the longest, respectively, at the highest mite density. The percentage of leaves with erineae, as well as the number and diameter of erineae increased along with the mite density. Mites in buds and on leaves with erineae were many more at the highest treatment level in Rishbaba and Sezdang Ghalat than in the other cultivars. Almost all data collected in the current experiments suggested that Sahebi Uroomie and Shahani were less affected by GEM than the other cultivars (Khalili Bovanat, Rishbaba and Sezdang Ghalat), whose plant responses were more pronounced as well as mite densities on leaves and in buds.

Sublethal effects of a *Beauveria bassiana*-based mycopesticide on the two-spotted spider mite (Acari: Tetranychidae)

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The effects of mycopesticide Naturalis® (an oil-carrier formulation of conidiospores of *Beauveria bassiana* strain ATCC 74040; Biogard, CBC Europe) on behavior and population growth of the two-spotted spider mite, *Tetranychus urticae* Koch, were investigated in laboratory bioassays. The mycopesticide was applied to bean primary leaves or leaf discs by using a Potter spray tower, producing a wet deposit of 2.7 ± 0.2 mg/cm². In a choice bioassay, *T. urticae* females preferred the untreated halves of leaves over the halves treated with serially diluted mycopesticide concentrations ranging 0.82-7 ml/l, and they laid in those treatments significantly more eggs on the

untreated halves in the first 24 h, as well as summed over 72 h. A run-off effect, ranging 21-61 % after 72 h, was also observed. These behavioral effects were attributed to the soybean oil, a carrier in the formulated product. Viability and reproduction of *T. urticae* females that survived treatment with 3 ml/l of the mycopesticide at the egg stage or during the preoviposition period were evaluated in two successive life-table bioassays. The females that hatched from the treated eggs and completed juvenile development on treated surface had significantly lower both gross (*GRR*) and net (R_o) reproductive rates than control females ($GRR = 72.55$ and 87.57 ; $R_o = 40.50$ and 63.80 , respectively); the intrinsic rate of increase in the treatment ($r_m = 0.249$) was significantly reduced as well, compared to the control ($r_m = 0.269$). The females that survived treatment at their preoviposition period had slightly but not significantly higher gross reproductive rate than control females ($GRR = 72.65$ and 67.21 , respectively); however, they had both net reproductive rate and the intrinsic rate of increase significantly lower compared to control females ($R_o = 43.52$ and 55.18 ; $r_m = 0.268$ and 0.281 , respectively).

Acaricidal and sublethal effects of a *Chenopodium*-based botanical pesticide on the two-spotted spider mite (Acari: Tetranychidae)

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The effects of the botanical pesticide Requiem® 25EC (containing 25% essential oil extract of *Chenopodium ambrosioides* near *ambrosioides*; Bayer CropScience) on the two-spotted spider mite, *Tetranychus urticae* Koch, were evaluated in laboratory bioassays. The pesticide was applied to bean primary leaves or leaf discs by using a Potter spray tower, producing a wet deposit of 2.7 ± 0.2 mg/cm². Acaricidal activity against eggs and immature, based on the number of treated individuals reaching the adult stage, was evaluated in successive acute toxicity bioassays. Concentration-mortality data were subjected to probit analysis and the following LC₅₀ values (ml/l) were calculated: 2.47 (eggs), 0.71 (larvae), 1.13 (protonymphs), 2.23 (female deutonymphs), and 6.02 (female teleiochrysalis). In adult bioassay, in which preovipositional females were treated with a series of concentrations (0.31-10 ml/l), a run-off effect ranging 4-80 % (after 24 h) and 8-93% (after 72 h) was observed. In two-choice bioassay, *T. urticae* females preferred the untreated halves of leaves over the halves treated with 1.25-10 ml/l and they laid in those treatments significantly more eggs on the untreated halves in the first 24 h and summed over 72 h. The indices of repellency and oviposition deterrence ranged 31.5-77.3 %, and 42-87.9 %, respectively. In age-stage two-sex life table bioassay, the females that hatched from eggs treated with 2.5 ml/l and reached adulthood on treated leaf surface had significantly reduced the intrinsic rate of increase ($r_m = 0.222$), compared to the control ($r_m = 0.317$). The reduction of population growth was mainly due to reduced preadult survival rate (0.42) and extended juvenile developmental time (9, 3 days), compared to the control (0.93, and 7.7 days, respectively). Besides concentration-mortality assessment across life stages, our study represents the first report on sublethal effects of this important botanical pesticide on two-spotted spider mites.

Stability of fenprothrin resistance in *Phytoseiulus macropilis* and cross-resistance in the pyrethroids group

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Tetranychus urticae Koch (Acari: Tetranychidae) is a polyphagous and cosmopolitan pest, with numerous reported cases of pesticide resistance. *Phytoseiulus macropilis* Banks (Acari: Phytoseiidae) is an effective predator of *T. urticae*. One of the obstacles to the use of predatory mites in pest control is the harmful effect of pesticides used to control pests in agriculture. The use of resistant strains of predatory mites can promote the conservation of these natural enemies. The stability of pesticide resistance, even in the absence of selection pressure, is an important feature on predators, since it can ensure their preservation when non-selective pesticides are used for pest control. The purpose of this research was to study the stability of fenprothrin resistance and cross-resistance to



different pyrethroids in *P. macropilis*. The stability of fenpropathrin resistance in *P. macropilis* was studied in two separate populations, with initial frequencies of 75 and 50% resistant mites respectively. Evaluations to verify the remaining percentages of resistant mites in both populations were conducted on monthly basis for a period of 12 months. Toxicity tests were conducted using the same populations of *P. macropilis* (susceptible and resistant). Fenpropathrin, bifenthrin and deltamethrin pyrethroids have been tested. In this study, fenpropathrin resistance presented a sharp decline trend during the initial test phase (3-4 months) in the absence of selection pressure. However, after this initial phase of sharp decline was past, the resistance to fenpropathrin tended to stabilization, and constant frequencies of around 30% were observed from that point until the end of the evaluation period. High resistance ratios ($LC_{50} R / LC_{50} S$) were observed for fenpropathrin (5,348), bifenthrin (738) and deltamethrin (725), indicating a possible cross-resistance within the group of pyrethroids.

Detection of Passion fruit green spot virus (PFGSV), a *Brevipalpus*-transmitted virus in the mite vector *B. yothersi*

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In mid 1990's a serious outbreak of a viral disease, coined "green spot" destroyed most of the small passionflower (*Passiflora edulis* f. *flavicarpa*) plantations in Vera Cruz, SP, Brazil. This disease is characterized by the appearance of green spots in yellow fruits and lesions in the stem, followed by the death of the plant due to the annealing resulting from the coalescence of stem lesions. Green leaves show no symptoms, but green patches can be produced along the mid vein in senescent leaves where virions are present. The causal agent was identified as a virus transmitted by *Brevipalpus phoenicis* (*latu sensus*), of cytoplasmic type - Passion fruit green spot virus (PFGSV). PFGSV have also been found in several other states of Brazil. Experimentally some *Passiflora* species showed to be susceptible. Partial sequence of PFGSV genome is known, indicating differences with other known *Brevipalpus*-transmitted viruses (BTV) as CiLV-C and SvRSV. Primers for detection of PFGSV are available. Experimentally it was transmitted by *B. yothersi*. Detection of PFGSV in the vector after acquisition feeding period of 24 h and transmission to common bean as indicator plant was successful and confirmed by two sets of primers designed to amplify part of the polymerase or MP regions. Other BTV (CiLV-C, SvRSV, CiLV-N, OFV, CICSV) have previously been detected in the mite vector, and such information will give support for epidemiological studies and to understand the virus-vector relationships.

Pollen provisioning enhances the performance of *Amblydromalus limonicus* on an unsuitable prey

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Amblydromalus limonicus is a polyphagous phytoseiid predator used for the biological control of thrips in greenhouse crops. Besides various prey species, *A. limonicus* can also feed on pollen of different plants. We recently showed that cattail pollen is suitable for the development and reproduction of *A. limonicus* and thus, it could sustain its populations in periods of prey scarcity. In addition, mixing high quality prey (thrips) with pollen was shown to positively affect the performance of *A. limonicus* through a significant increase in the predator's numerical response. In the present study, we hypothesized that pollen provisioning may also benefit *A. limonicus* in mixed diets with low quality prey, such as with spider mites. For this, the survival, development and oviposition of the predator were assessed for a mixed diet consisting of spider mites and cattail pollen. We also recorded the number of spider mite individuals that were consumed by *A. limonicus* adults in the presence or absence of pollen. Our results show that pollen significantly increased the survival and oviposition of the predator when mixed with spider mites, although negatively affecting its predation rate. We conclude that cattail pollen may positively affect

the numerical response of *A. limonicus* irrespectively of the quality of the prey. In comparison with our previous findings for the high quality prey, the positive effect of pollen provisioning was even more pronounced for the low quality prey. Pollen as supplementary food source may thus expand the prey species range that *A. limonicus* could exploit.

Brevipalpus species found in Coffee ringspot virus (CoRSV)-infected plants in Brazil

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The genus *Brevipalpus* belongs to the Tenuipalpidae family and are commonly known as flat mites. Some species act as vector of plant viruses. Among these viruses Coffee ringspot virus (CoRSV) is of economic importance causing leaf fall associated with loss of production and quality in coffee beverage. Symptoms (ringspots on leaves and berries) have been reported in most of coffee growing regions in Brazil and also in Costa Rica. The aim of this study was to identify the possible species that occur in symptomatic coffee plants in some coffee growing areas in the states of São Paulo, Minas Gerais and Paraná, trying to determine which species acts as vectors of this virus. Inspections were made in coffee fields with CoRSV symptoms in São Paulo, Campinas and Piracicaba, SP, Lavras, MG and São José do Patrocínio, PR. Collected *Brevipalpus* specimens were analyzed by light and scanning electron microscopy and by molecular markers. These studies revealed the presence of three species: *B. yothersi*, *B. papayensis* and *B. phoenicis*. Additionally, in Lavras, Campinas and São Paulo, two species, distinct from previously identified species, were found differing in some morphological characteristics. In S.J. Patrocínio *B. yothersi* was the only detected species and is likely to be the vector CoRSV in this locality. However, in other sites there were mixed populations of *Brevipalpus*, thus it was not possible to determine if only one or more species may be acting as vector for CoRSV. Because mixed infestation of plants by two or more *Brevipalpus* species seems to be a quite frequent situation, a more detailed transmission assays, allied with a careful identification of involved *Brevipalpus* mites are required, and most of previously reported cases of vectors for other *Brevipalpus* transmitted viruses should be revised.

Chemical Control, Resistance and Toxicology

Molecular characterization of pyrethroid resistance in *Varroa destructor* (Acari: Varroidae) populations from Greece

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The mite *Varroa destructor* is the most serious pest of honeybees worldwide and its control is mainly based on the use of synthetic acaricides, which, in many cases, has led to the development of resistance. In Greece, evidence of resistance to the pyrethroid tau-fluvalinate goes back to the early '90's, however the extend and the mechanism of resistance have not been studied so far. In the present study we examined the presence of resistance mutations at the voltage gated sodium channel (vgsc) gene, encoding the target of pyrethroids. Comparison of the sequence of the IIS4-IIS5 region of the vgsc gene from susceptible and resistant mites revealed two amino acid replacements at position 925: one is a leucine to valine substitution (L925V) previously implicated in pyrethroid resistance of *V. destructor* from Northern European countries as well as a novel resistant mutation for *V. destructor* a leucine to isoleucine substitution (L925I). No mutations at two other 'hot spot' resistance positions, 918 and 929 of



the *vgsc* gene encompassing position 925 were identified. We furthermore examined the frequency of resistance mutations by genotyping 113 *V. destructor* individuals from 7 regions of Greece. Resistant alleles were predominant (54%) with 83% of them corresponding to the L925I substitution. Moreover, genotyping results showed the presence of homozygous wild type 925L (44%) individuals as well as homozygous resistant 925I (40%) and 925V (7%), while also heterozygous individuals (925I/L, 925I/V, 925V/L) were present at low frequency (5.3, 2.6 and 0.9 respectively). Our results clearly show the presence of pyrethroid resistant mutations in high frequency in Greek varroa populations, which is in accordance with the reports of ineffective control of *V. destructor* with tau-fluvalinate and flumethrin.

Resistance ratio, detoxification enzyme activity and mutation of *Tetranychus urticae* Koch (Acari: Tetranychidae) in populations of collected from greenhouses in Turkey against abamectin

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The two-spotted spider mite *Tetranychus urticae* is very important agricultural pest with an extensive host plant range and an extreme record of pesticide resistance. Abamectin shows nematocidal, acaricidal and insecticidal activities. Response of three populations of the two-spotted spider mite, *Tetranychus urticae* Koch, collected from greenhouses in Antalya (Antalya) and Muğla (Fethiye1 and Fethiye2) province of Turkey against abamectin was determined by a petri dish bioassay method and biochemical assay. Resistant ratios of populations were calculated by dividing the LC_{50} values of greenhouse populations by that of a susceptible population of *T. urticae* strain (GSS). The resistance ratio of Fethiye 1, Fethiye 2 and Antalya populations was determined as 217.12, 256.2, 392.5 folds against abamectin by comparing susceptible strain GSS at LC_{50} , respectively. To determine biochemical resistance mechanism to abamectin, some synergist [piperonyl butoxide (PBO), *S*-benzyl-*O,O*-diisopropyl phosphorothioate (IBP), and diethyl maleate (DEM)] were applied with abamectin to all spider mite populations. Synergistic ratio on the cypermethrin in Antalya, Fethiye1 and Fethiye2 populations were 1.27, 1.14 and 1.46 fold for PBO, 5.44, 4.5 and 7.76 fold for IBP and 0.85, 2.19 and 1.70 DEM, respectively. The activities of esterase, glutathione S-transferase (GST) and cytochrome P450 was determined using α -naphthyl acetate, 1-chloro-2,4 dinitrobenzene (CDNB) and 7-ethoxycoumarin (7-EC) as substrates, respectively. In Antalya, Fethiye 1, Fethiye 2 strains, activities of esterase, glutathione S-transferase and cytochrome P450 2.02, 1.74, 1.42; 1.39, 1.38, 1.01 and 4.5, 1.65, 2.73 fold higher, respectively when compare with parental susceptible population (GSS). The presence of known abamectin resistance target site mutations (G314D and G326D) on the glutamate gated chloride channels was checked, but not found in any of the resistant strains, indicating that. According to these results, detoxification enzymes but no target site intensity seems to have an important role in abamectin resistance, in field *T. urticae* populations from Turkey.

Biochemical and Molecular Characterization of Cypermethrin Resistance in *Tetranychus urticae* Koch. (Acari: Tetranychidae)

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The two-spotted spider mite, *Tetranychus urticae* Koch, is one of the most important agricultural pests worldwide. It is extremely polyphagous and develops resistance to acaricides. Cypermethrin, a synthetic pyrethroid, is used for controlling insects in the agricultural fields. A susceptible strain *T. urticae* (GSS) was selected with cypermethrin for 6 selections (or generations) in the laboratory. The level of cypermethrin resistance was 54.7-fold higher in the C6 strain compared to the parental susceptible GSS strain. Synergistic ratios on the cypermethrin in *T. urticae* were 1.54, 1.68 and 2.27- fold for PBO, IBP and DEM, respectively. No synergism by IBP, PBO and DEM

was observed in the susceptible population. The activities of esterase, glutathione S-transferase and cytochrome P450 was determined using α -naphthyl acetate, 1-chloro-2,4 dinitrobenzene (CDNB) and 7-ethoxycoumarin (7-EC) as substrate, respectively. In the C6 strain, activities of esterase, glutathione S-transferase and cytochrome P450 1.58, 1.16 and 1.35 fold higher, respectively, when compare with parental susceptible population (GSS). No known mutations (F1538I, L1025V and A1215D) were detected on the sodium channel, the target site of pyrethroid insecticides. Our results indicate a detoxification-based cypermethrin resistance mechanism associated with the resistance phenotype of the C6 strain.

Acaricidal activity of *Lavandula latifolia* essential oil: effects on mortality and fecundity of two-spotted spider mite

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Tetranychus urticae (two-spotted spider mite) causes major yield loss in numerous food crops and ornamental plants. The control of this mite is achieved mainly with synthetic acaricides; other strategies use predatory mites or plant natural products. This study evaluated the effects of *Lavandula latifolia* (spike lavender) essential oil on the survival and fecundity of the two-spotted spider mite by slide-dip and leaf-disk bioassays. Acute contact toxicity was provoked by different spike lavender oil doses, although 95-100% mortality was observed when emulsions contained at least 0.20% (v/v). In the residual toxicity experiments, lavender oil (0.15% or 0.25%) reduced spider mite survival and affected its fecundity as the total number of oviposited eggs and emerging larvae lowered as the oil dose increased. Incubation temperature determined egg viability since the lowest temperature assayed (12 °C) did not allow larva development while the highest percentage of hatched eggs was counted at 30 °C. Our data indicate the acaricidal power of spike lavender oil, which markedly reduced *T. urticae* population. This effect was the combined result of increased mortality and decreased spider mite fecundity, which confirms the feasibility of spike lavender oil as an alternative to conventional pesticides.

Stability and monitoring of spiromesifen resistance in *Tetranychus urticae* Koch (Acari: Tetranychidae)

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The two-spotted spider mite, *Tetranychus urticae* Koch, causes serious damages in various crops in Brazil. One of the problems faced by farmers has been the difficulty to control this pest through the use of agrochemicals. Studies on artificial selections, stability of resistance and monitoring of spiromesifen resistance were carried out to provide basic information for the establishment of acaricide resistance management program for the spider mite in Brazil. Artificial laboratory selections for resistance to spiromesifen were performed in a population of *T. urticae*, originated from a mixture of mites from four field populations of the spider mite, collected in commercial chrysanthemum fields in the State of São Paulo, Brazil. After 20 selections, the spiromesifen resistance ratios ($LC_{50} R$ divided by $LC_{50} S$) reached values higher than 100-folds. Spiromesifen resistance was shown to be unstable in the absence of selection pressure, with significantly decrease in the percentage of resistant mites in a period of six months. The evaluation of 23 spider mite populations, collected from several crops (chayote, cotton, kidney beans, soybean, raspberry, papaya, strawberry, gerbera, chrysanthemum and roses), in the States of Goiás, Mato Grosso and São Paulo, in Brazil, indicated that the susceptibility of *T. urticae* to spiromesifen was variable, with percentages of resistant mites ranging from 0.0 to 82%. The highest resistance frequencies were observed in roses and chrysanthemum in the State of São Paulo. Populations of *T. urticae* with more than 25% of resistant mites were also detected in strawberry fields, in the same State. The spider mite populations from chayote, cotton, kidney beans, soybean, raspberry and papaya were susceptible to spiromesifen.



Domestic mites of Valencian Community in Spain: Influence of climatic and environmental factors

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Domestic mites are considered the main source of allergens in indoor environments, and the knowledge of the mite species presents in homes is very important for a correct diagnosis and treatment of allergic diseases. Our objective was to determine the mite fauna on mattresses in the Valencian Community in Spain, and to assess the influence of geographical, climatic, socioeconomic and dwelling factors. We collected 319 samples of dust from the surface of mattress using a modified portable vacuum cleaner, in homes from eight different climatic zones. A questionnaire about the home environment was filled. After collection, samples were immediately frozen. Mites were isolated, from dust samples using a modified suspension method, identified and counted. At least one mite species was found in 71% of the samples. More than 30 mite species were identified, but *Dermatophagoides pteronyssinus* (present in 48% of the total samples) and *D. farinae* (38%) were, by far, the most frequent and abundant species in all the areas. *Tyrophagus putrescentiae* (7%), *Euroglyphus maynei* (6%) and *Glycyphagus domesticus* (5%) were the most frequent non-*Dermatophagoides* species, reaching higher levels in certain areas. Significant differences were observed among climatic zones, with higher presence of mites in coastal areas than inland but with different dominant *Dermatophagoides* species. Furthermore, others factors such as humidity, distance to the sea, rural or urban habitat or socioeconomic levels were associated with higher levels of mites. This study demonstrates the existence of a diverse domestic mite fauna in Valencian Community, with significant differences in mite number and species, depending on the climatic areas and on residential characteristics.

Population fluctuation of the dried fruit mite, *Carpoglyphus lactis* (Carpoglyphidae) and determination of Aflatoxin level on dried apricot samples obtained from Egyptian markets.

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Dried apricots are especially sensitive to mite contaminations. *Carpoglyphus lactis* is an important stored product mite, which not only inflicts heavy damage to stored sugar, dried fruit and sweet chow but also causes acariasis in humans. In this study, we analyzed the mite contamination of and population fluctuation of the dried fruit mite, *Carpoglyphus lactis* (Carpoglyphidae) on dried apricot samples obtained from Egyptian markets. Also, determination the Aflatoxin level in dried apricot sample using AflaTest column then measured in a fluorometer, VICAM series -4 and study the relation between dried fruit mite, *C. lactis*, and Aflatoxin level. The data showed a reduction in dried fruit mite, *C. lactis* populations during winter months from December to February and predominant in the summer months. The growth of the *C. lactis* population started in March and ended in November with a peak in August (50.2+2.5 mite/g dried apricot). Aflatoxin produced by members of *Aspergillus flavus* and *A. parasiticus* are potent hepatotoxic, mutagenic and carcinogenic toxins causing serious health hazards to humans and animals. Results showed that the total Aflatoxin (Ppb/Kg) in dried apricot samples infested by *C. lactis* populations ranged from 5 – 15 Ppb/Kg. Also, samples were contaminated with aflatoxin B1 (AFB1) in the range of 2.10 – 3.47 Ppb/Kg.

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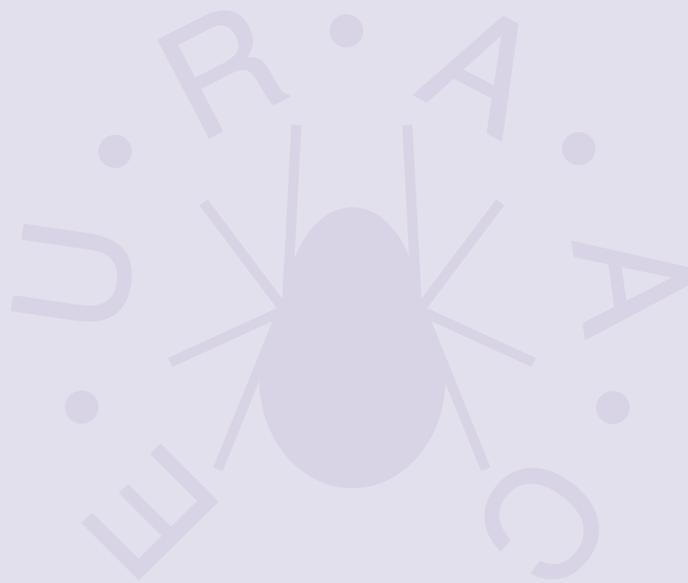
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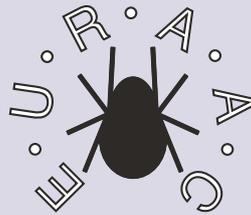
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