Asociación Latino Americana de Ecología Química
Associação Latino Americana de Ecologia Química
Latin American Association of Chemical Ecology

5th Congress
of the **Latin American Association of Chemical Ecology** (ALAEQ)

Book of Abstracts

October 23-26, 2018, Valparaíso, Chile

5th Congress of the Latin American Association of Chemical Ecology (ALAEQ)

October 23-26, 2018
Valparaíso, Chile

Organized by

Latin American Association of Chemical Ecology (ALAEQ)

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Dr. Paulo Zarbin – Universidade Federal do Paraná, Brazil.

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WELCOME LETTER

Dear colleagues,

It is with great pleasure that we welcome you to Valparaíso, Chile, and to the 5th Meeting of the Latin American Association of Chemical Ecology (ALAEQ).
Since its foundation in 2009, the history of ALAEQ has been a great success. The meetings held every two years since 2010 have regularly had around 150 attendants and have been superb opportunities to show the diversity and the excellence of the Chemical Ecology research carried out in Latin America. This year, again ca. 140 participants from 12 countries will gather in Valparaíso.

From the very beginning, ALAEQ has sought the connection with researchers from outside Latin America, which has helped to establish ALAEQ as an important player in Chemical Ecology in the international context. For example, in 2016 the International Society of Chemical Ecology (ISCE) and ALAEQ held a joint meeting in Brazil, and we are confident that there will be another joint meeting ISCE-ALAEQ in the near future. On the other hand, since 2018, the Journal of Chemical Ecology is the official platform for ALAEQ, together with ISCE and the Asia-Pacific Association of Chemical Ecologists (APACE), with truly is a great honor and recognition for ALAEQ. In order to continue the integration of the societies/associations, we are happy that at this meeting leading members of ISCE, APACE, and ALAEQ will discuss the current status and future perspectives for collaboration.

We thank all participants for coming to Valparaíso and presenting their exciting research at this meeting. We are also grateful for generous financial support received by ChemTica International, ShinEtsu, Syntech, and the Pontificia Universidad Católica de Valparaíso.

We hope you will have an enjoyable and productive meeting!

Jan Bergmann, Eduardo Fuentes-Contreras, Marcia González-Teuber & Cristian Villagra
Organizing Committee ALAEQ5

EMERGENCY PLAN INFOGRAPHIC

Infografía Plan de Emergencia

Security Zone

Area located at the front of the building on Av. Brasil

Meeting point Cota ’30: In front of the Colegio Patrocinio San José on Av. Alemania

Plans: Location of extinguishers and evacuation routes

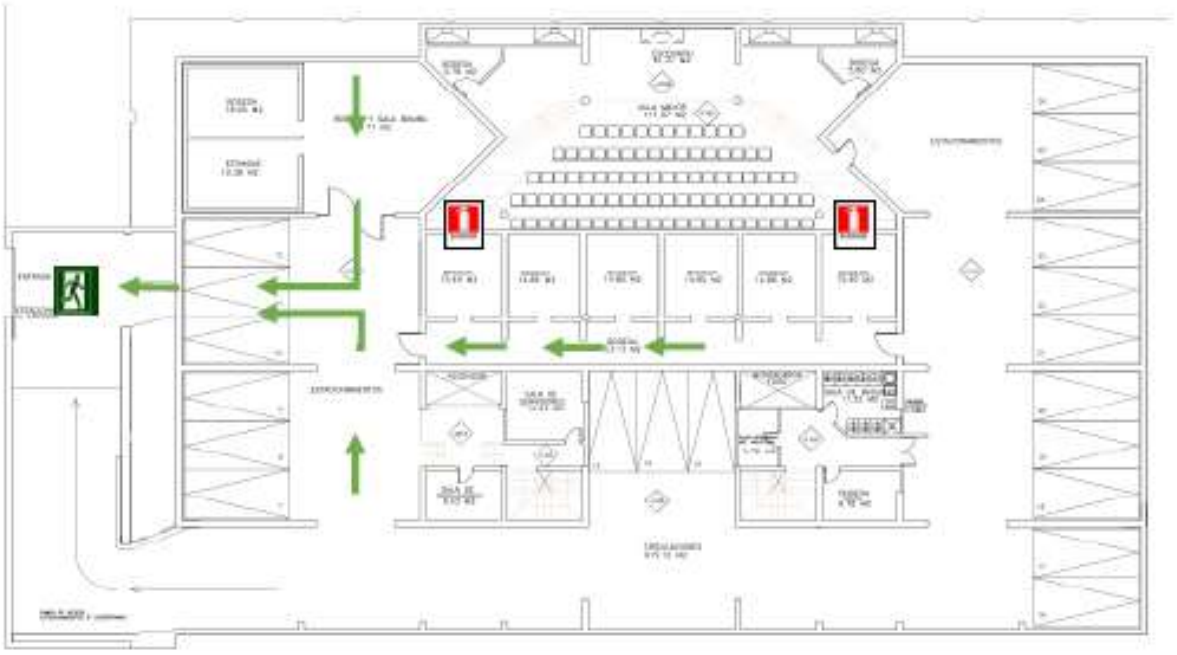
Symbology:

Portable fire extinguisher

Wet riser

Emergency exit

Underground level:



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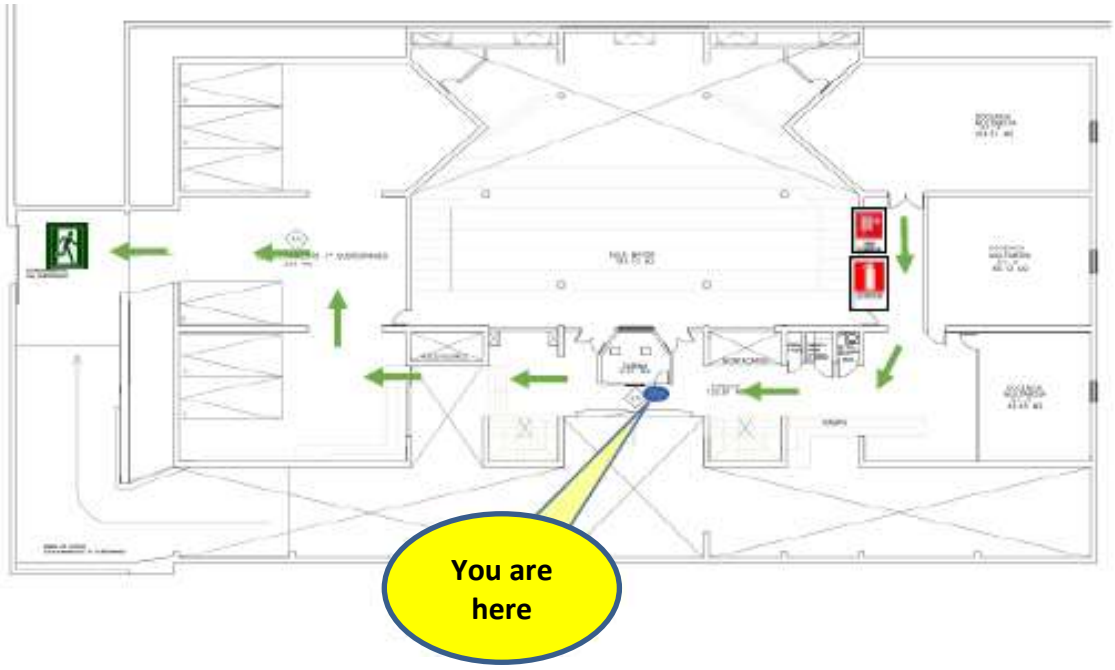

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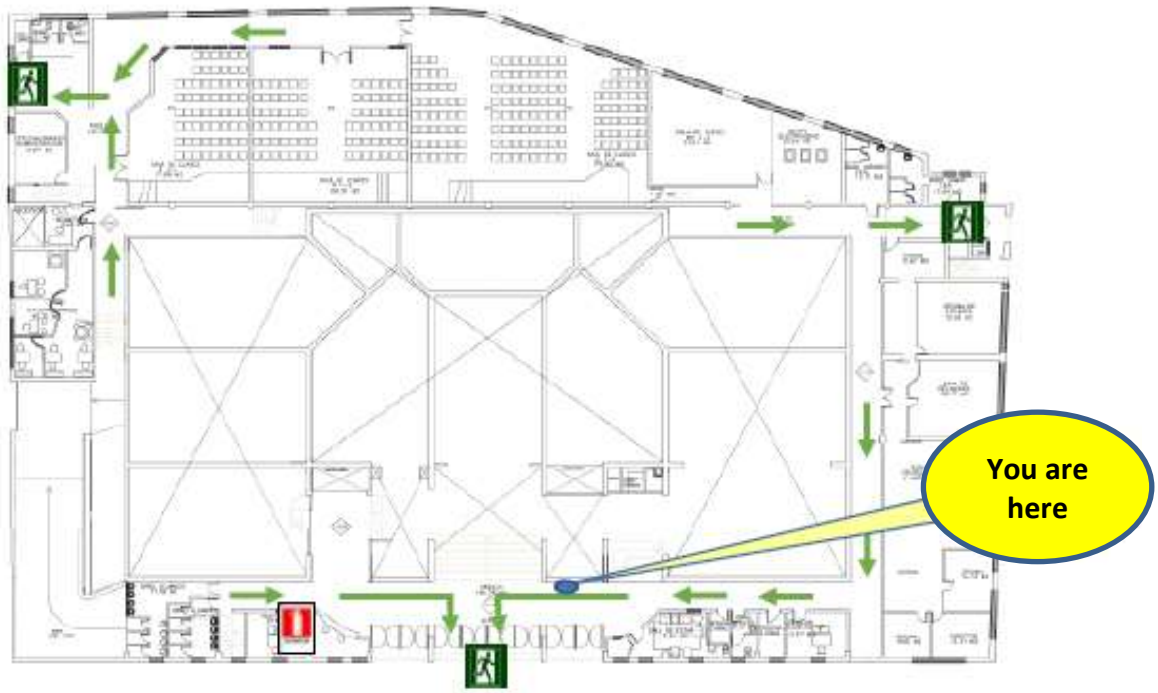

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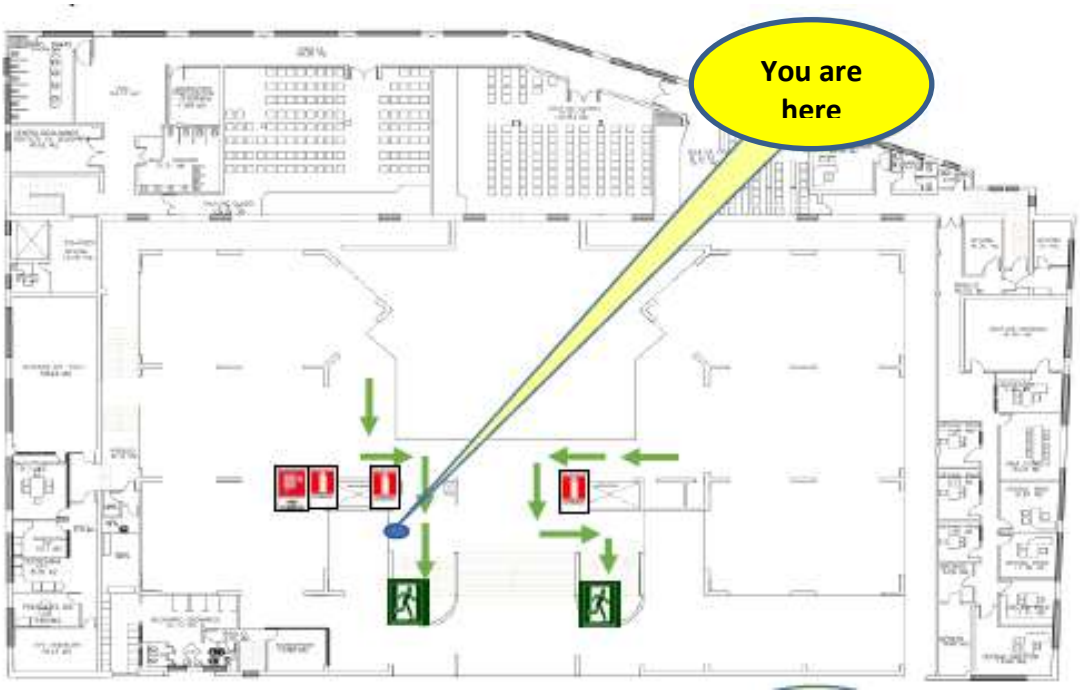

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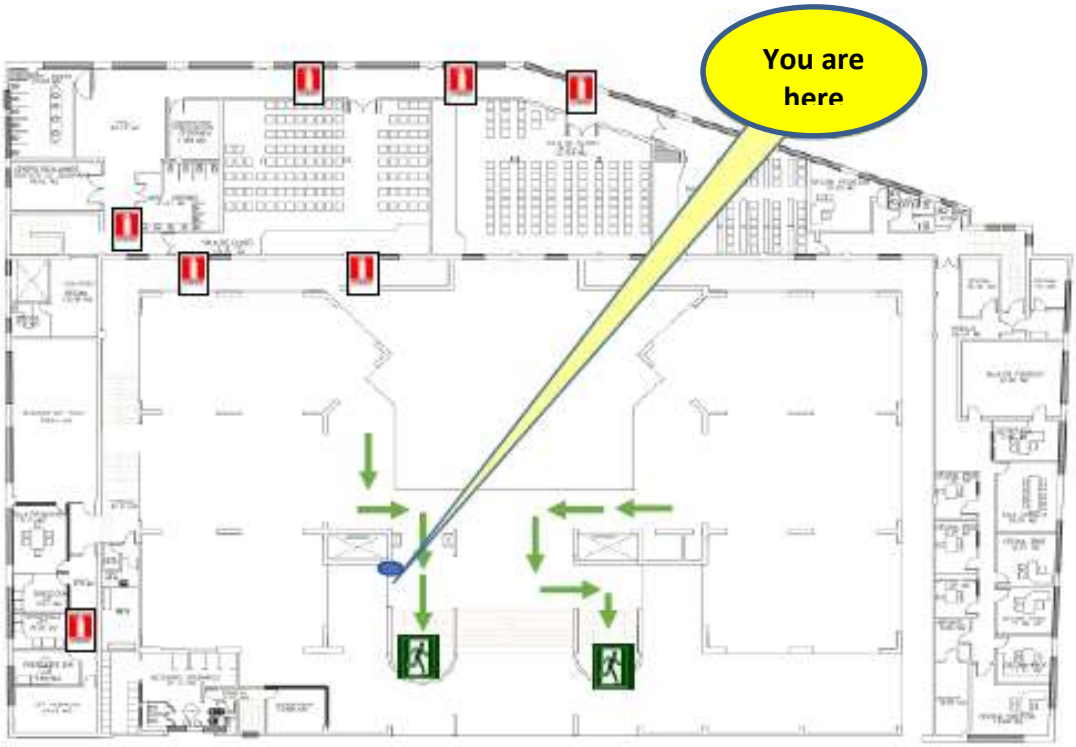

PROGRAM

Monday, October 22

16:00-18:00 h: **REGISTRATION**

Tuesday, October 23

08:30-9:30 h: **REGISTRATION**

9:30-10:00 h: **OPENING CEREMONY**

Paulo H. G. Zarbin: President of ALAEQ
Jan Bergmann: Organizing Committee 5th ALAEQ

10:00-10:45 h: **CONFERENCE 1 "Common principles in plant defense and carnivory"**

Chair: Marcia González-Teuber

Speaker: **Axel Mithöfer**

Department of Bioorganic Chemistry Plant Defense – Max Planck Institute for Chemical Ecology. Jena, Germany.

10:45-11:15 h: **COFFEE BREAK**

11:15-12:45 h: **SYMPOSIUM 1 "Plant – animal interactions"**

Chairs: José Mauricio S. Bento, Cristian A. Villagra

Influence of Silicon on plant-insect interactions: ecological and applied perspectives. ***M Fernanda Gomes Villalba Peñaflor***. Departamento de Entomologia – Universidade de Lavras, Lavras. Brazil.

About the recursive nature of plant-pollinator interactions.***Jaime Martínez- Harms***. Instituto de Investigaciones Agropecuarias (INIA), La Cruz. Chile.

Influorescence scent and morphology effect on floral visitor guild of *Haplopappus* (Asteraceae) hybridzone. ***Cristian A. Villagra***. Instituto de Entomología, Universidad Metropolitana de Ciencias de la Educación, Santiago. Chile.

12:45-14:15 h: **LUNCH**

14:15-15:45 h: **SYMPOSIUM 2 "Modulation of odor-guided behavior"**

Chair: Pablo Guerenstein

Smelling the past: Insects' olfactory responses can be widely modulated by previous experiences. ***Sebastian Minoli***. Laboratorio de Fisiología de insectos, DBBE-FCEN, IBBEA, CONICET-UBA, Universidad de Buenos Aires, Buenos Aires. Argentina.

Does insect behaviour change as barometric pressure change? ***José Mauricio S. Bento.*** University of São Paulo – Dept. of Entomology and Acarology. Brazil.

Preliminary evidence of triatomine host-seeking behavior modulation by a new repellent of bacterial origin. ***Melanie Ramirez***. Universidad de los Andes, Bogotá D.C. Colombia.

How resistance to transgenic crops affects the reproduction of a moth: case of *Spodoptera frugiperda*. ***Eraldo Lima***. Universidade Federal de Viçosa – Dep. de Entomologia, Viçosa. Brazil.

Effects of the ambient CO_2 level on the neurophysiology and behavior of lepidopterans. ***Pablo Guerenstein***. CICyTTP CONICET – UADER and Fac. de Ingeniería, Universidad Nacional de Entre Ríos, Entre Ríos. Argentina.

15:45-16:15 h: **COFFEE BREAK**

16:15-17:15 h: **ORAL PRESENTATIONS I**

Chair: Nancy Barreto

O-01 Sex pheromone influence on vibratory communication of the Neotropical brown stink bug, *Euschistus heros* (F) (Hemiptera: Pentatomidae). ***Aline Moreira Dias***. PPG Zoology, Department of Zoology, Biology Institute, University of Brasília, Brasília. Brazil.

O-02 Not presented.

O-03 Sapogenins of quinoa (*Chenopodium quinoa* Willd.) genotypes as sources for improved insect resistance**. *Rodrigo A. Chorbadjian***. Facultad de Agronomía and Ingeniería Forestal, Pontificia Universidad Católica de Chile, Santiago. Chile.

O-04 Chemical profile of the volatile compounds of *Baccharis salicifolia* (Asteraceae) and interaction with *Macrodactylus nigripes* (Coleoptera:

Melolonthidae). ***Ericka Nieves-Silva***. Benemérita Universidad Autónoma de Puebla, Centro de Agroecología, Puebla. Mexico.

17:15-18:00 h: **CONFERENCE 2 "Plasticity in insect olfaction"**

Chair: Romina B Barrozo

Speaker: **Sylvia Anton**

Institute for Genetics, Environment and Plant Protection INRA, Agrocampus Ouest – Université Rennes 1. Angers, France.

18:00-21:00 h: **WELCOME RECEPTION.**

Wednesday, October 24

9:00-9:45 h: **CONFERENCE 3 "Chemical signaling in insect-microbe symbiosis"**

Chair: Paulo Zarbin.

Speaker: **Mônica Pupo.**

Laboratory of Microbial Chemistry, School of Pharmaceutical Sciences of Ribeirão Preto, Department of Pharmaceutical Sciences – University of São Paulo. São Paulo, Brazil.

9:45-10:45 h: **ORAL PRESENTATIONS II**

Chair: Alicia Lorenzo.

O-05 Blend of oviposition-attracting larval holding water compounds as control strategy for *Aedes aegypti* (Diptera: Culicidae). ***Paula González***. Centro de Investigaciones de Plagas e Insecticidas (CIPEIN-UNIDEF-CONICET), Buenos Aires. Argentina.

O-06 Biological activities of natural abenquines and their synthetic analogues. ***Amalyn Nain – Pérez***. Department of Chemistry, Universidade Federal de Minas Gerais, Belo Horizonte. Brazil.

O-07 Not presented.

O-08 Quinocyclines from *Micromonospora tulbaghiae* ICBG1321, a symbiont of the stingless bee *Melipona scutellaris*. ***Diego Rodríguez-Hernández***. School of Pharmaceutical Sciences of Ribeirão Preto, University of São Paulo, São Paulo. Brazil.

10:45-11:15 h: **COFFEE BREAK**

11:15-12:45 h: **SYMPOSIUM 3 "Molecular and neurobiological bases of chemoreception"**

Chair: Romina B Barrozo

Some salt, not too much… how to solve this sensory complexity with the same gustatory receptors? ***Romina B Barrozo***. Grupo de Neuroetologia de Insectos Vectores, Laboratorio de Fisiología de Insectos, IBBEA CONICET – UBA, DBBE, FCEyN, Universidad de Buenos Aires, Buenos Aires. Argentina.

Antennal expression profile of the sensory gene repertoire of *Triatoma infestans* after blood-feeding. ***Marcelo Lorenzo***. Fundação Oswaldo Cruz – Minas. CVIP – IRR. Brazil.

Age-dependent regulation of host seeking in mosquitoes. ***Rickard Ignell***. Disease Vector Group, Department of Plant Protection Biology, Swedish University of Agricultural Sciences, Alnarp. Sweden.

Aedes aegypti mosquitoes use the IR8a olfactory receptor pathway to detect human odor. ***Matthew DeGennaro***. Department of Biological Sciences, Florida International University, Miami. USA.

12:45-14:15 h: **LUNCH**

14:15-15:45 h: **SYMPOSIUM 4 "Chemical ecology of disease vectors"**

Chairs: Álvaro Eiras, Marcelo Lorenzo.

Synthetic attractants for monitoring host-seeking anophelines. ***Elis P.A. Batista***. Laboratório de Ecologia Química de Insetos Vetores – Instituto de Ciências Biológicas/ Universidade Federal de Minas Gerais, Belo Horizonte. Brazil.

Responses of central olfactory neurons: Looking for an odor blend to attract triatomines. ***Lucía Ibarra Bouzada.***CICYTTP, Entre Ríos, and Fac. de Bioquímica y Cs. Biológicas, Santa Fe. Argentina.

Salt perception in a hematophagous insect: linking peripheral detection to behavior. ***Gina Pontes***. Grupo de Neuroetologia de Insectos Vectores, Laboratorio de Fisiología de Insectos, IBBEA CONICET – UBA, DBBE, FCEyN – Universidad de Buenos Aires, Buenos Aires. Argentina.

Effect of mosquito age, experience and infection status on DEET efficacy in the malaria mosquito *Anopheles gambiae* s.s. ***Margaux Mulatier***. L'Institut de recherche pour le développement IRD, Montpellier. France.

15:45-16:15 h: **COFFEE BREAK**

16:15-16:45 h: **ORAL PRESENTATIONS III**

Chair: Diogo Vidal

O-09 The sensory physiology of host-associated stimuli evaluation in head lice. ***Isabel Ortega Insaurralde***. Centro de investigaciones de plagas e insecticidas, Unidad de investigación y desarrollo para la defensa, Buenos Aires. Argentina.

O-10 Not presented.

16:45-17:30 h: **CONFERENCE 4 "Chemical ecology in and around homes: semiochemicals used right under our noses"**

Chair: Cristian Villagra

Speaker: **Coby Schal.**

Department of Entomology, North Carolina State University. Raleigh, North Carolina. USA.

17:30-19:00 h: **POSTER SESSION I (P-01 – P-41)**

Thursday, October 25

9:00-9:45 h: **CONFERENCE 5 "A journey through the chemical ecology of curculionid beetles"**

Chair: Andrés González

Speaker: **Paulo Zarbin.**

Laboratório de Semioquímicos, Universidade Federal do Paraná, Curitiba. Brazil.

9:45-10:45 h: **ORAL PRESENTATIONS IV**

Chair: Marcia González-Teuber

O-11 Insect-corn kernel interaction: Chemical signaling of the grain and host recognition by *Sitophilus zeamais*. ***Virginia L. Usseglio***. Instituto Multidisciplinario de Biología Vegetal (IMBIV) – UNC – CONICET. Instituto de Ciencia y Tecnología de los Alimentos (ICTA) – Facultad de Ciencias Exactas, Físicas y Naturales (FCEFyN) – Universidad Nacional de Córdoba (UNC), Córdoba. Argentina.

O-12 Kin recognition in a Subsocial Treehopper (Hemiptera: Membracidae). ***Daniel Torrico-Bazoberry***. Laboratorio de Química Ecológica, Departamento de Ciencias Ecológicas, Facultad de Ciencias, Universidad de Chile, Santiago. Chile.

O-13 Male –specific volatiles of the citrus borer, *Diploschema rotundicolle* (Coleoptera: Cerambycidae): Identification and field evaluation. ***María Eugenia Amorós.*** Facultad de Química, Universidad de la República, Montevideo. Uruguay.

O-14 Green and cost-effective synthesis of N-(2'S)-Methylbutyl-2-metylbutylamide, the sex pheromone of the longhorn beetle *Migdolus fryanus*. ***Vanderson Barbosa Bernardo***. Institute of Chemistry and Biotechnology, Federal University of Alagoas, Maceió. Brazil.

10:45-11:15 h: **COFFEE BREAK**

11:15-12:45 h: **SYMPOSIUM 5 "Identification and synthesis of semiochemicals"**

Chair: Paulo Zarbin

Chemical ecology of insect pests associated to Yerba Mate (*Ilex paraquariensis*). ***Diogo Vidal***. Universidade Federal de Minas Gerais, Belo Horizonte. Brazil.
Identification and synthesis of pheromones from agricultural and forestry pest insects in Chile. ***Jan Bergmann***. Instituto de Química, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile.

Synthesis of Pheromone for Insect Control. ***Vanderson Barbosa Bernardo***. Centro de Ciências Agrarias – CECA, Universidade Federal de Alagoas, Maceió AL. Brazil.

12:45-14:15 h: **LUNCH**

14:15-15:30 h: **ORAL PRESENTATIONS V**

Chair: Jaime Martínez-Harms

O-15 Are four better than two? Testing the attractiveness of a quaternary blend in males of *Diatraea saccharalis* in flight tunnel experiments. ***Maycon***

Silva. Laboratório de Semioquímicos – Departamento de Química, Universidade Federal do Paraná, Curitiba, Brazil.

O-16 Does Si fertilization alter the attractiveness of herbivore-induced plant volatiles to the minute pirate bug *Orius insidiosus*? ***Patricia Pereira.*** Departamento de Entomologia – Universidade de Lavras, Lavras. Brazil.

O-17 Integrating plant natural resources use and urban pests' control. The case of *Haplopappus platylepis* (Asteraceae) resin as a substrate for sticky trap. ***Cristian A. Villagra***. Instituto de Entomología, Universidad Metropolitana de Ciencias de la Educación, Santiago. Chile. Laboratorio de Sistemática y Evolución de Plantas, Departamento de Silvicultura y Conservación de la Naturaleza, Universidad de Chile, Santiago. Chile.

O-18 Response of *Apis mellifera* towards chemical compounds associated with *Varroa destructor* infested-brood. ***M. Clara Liendo***. Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) – Instituto de Genética Ewald A. Favret, Instituto Nacional de Tecnología Agropecuaria (INTA) – Hurlingham, Buenos Aires, Argentina.

O-19 Macrolides as possible kairomones from the Mediterranean flour moth (*Anagasta kuehniella)*. ***Douglas J. de Melo***. Chemistry Department, Universidade Federal do Paraná, Curitiba. Brazil.

15:30-16:00 h: **COFFEE BREAK**

16:00-17:30 h: **Podium discussion "ISCE, APACE, ALAEQ": Current status and perspectives for future collaborations"**

Moderator: Carmen Rossini, President Elect ALAEQ

Participants:

Coby Schal – President ISCE
Junwei "Jerry" Zhu – Former president APACE
Paulo Zarbin – President ALAEQ

17:30-19:00 h: **POSTER SESSION II (P-42 – P-84)**

Friday, October 26

9:00-9:45 h: **CONFERENCE 6 "Exploration of Green Chemistry for insect pest management: Applications of natural products for biting insect control"**

Chair: Eduardo Fuentes – Contreras

Speaker: **Junwei "Jerry" Zhu**

United States Department of Agriculture – Agricultural Research Service – The Agroecosystem Management Research Unit (USDA – ARS, AMRU). Lincoln, USA.

9:45-10:45 h: **ORAL PRESENTATIONS VI**

Chair: José Mauricio S. Bento

O-20 Impact of benzoxazinoid sequestration by the Western Corn Rootworm on the biocontrol potential of entomopathogenic nematode isolates from Mexico. ***Pamela Bruno***. Laboratory of Fundamental and Applied Research in Chemical Ecology, University of Neuchâtel, Neuchâtel. Switzerland.

O-21 Estimation of the scattering of *Diatraea crambidoides* Grote (Lepidoptera: Crambidae) using traps with sexual pheromone in sugar cane crop. ***Marvin Pec***. Department of Entomology, Federal University of Lavras, Lavras. Brazil.

O-22 Improved monitoring of oriental fruit moth (Lepidoptera: Tortricidae) with terpinyl acetate plus acetic acid membrane lures. ***Eduardo Fuentes-Contreras***. Millennium Nucleus Centre in Molecular Ecology and Evolutionary Applications in the Agroecosystems (CEM), Facultad de Ciencias Agrarias, Universidad de Talca, Talca. Chile.

O-23 Big avocado seed weevil *Heilipus lauri* management with volatile organic compounds produced by males of this species. ***Alicia Romero-Frias***. Universidad Antonio Nariño, Bogotá. Colombia.

10:45-11:15 h: **COFFEE BREAK**

11:15-12:45 h: **SYMPOSIUM 6 "Semiochemicals and pest management"**

Chair: Andrés González

Panel and multiple-funnel intercept trap performance varies among taxa: Why? ***Jeremy Allison***. Canadian Forest Service, Sault Ste. Marie. Canada.

Use of pheromones for the management of mealybugs (Hemiptera: Pseudococidae) in fruit crops. ***Tania Zaviezo***. Facultad de Agronomía e Ingeniería Forestal, Pontificia Universidad Católica de Chile, Santiago. Chile.

Semiochemicals for the management of *Lobesia botrana* (Lepidoptera : Tortricidae) in Chile. ***Eduardo Fuentes-Contreras***. Millennium Nucleus Centre in Molecular Ecology and Evolutionary Applications in the

Agroecosystems (CEM), Facultad de Ciencias Agrarias, Universidad de Talca, Talca. Chile.

Mating disruption of native leafrollers: A supplementary management tool for pheromone – based control of primary Orchard Pests. ***Andrés González.*** Facultad de Química, Universidad de la República. Uruguay.

12:45-14:15 h: **LUNCH**

14.15-14:45 h: **AWARD CEREMONY**

14:45-16:15 h: **ALAEQ GENERAL ASSEMBLY**

Abstracts of Conferences

Tuesday, October 23 (10:00-10:45 h)

Common principles in plant defense and carnivory

Axel Mithöfer[1*]

[1]*Dept Bioorganic Chemistry / MPI for Chemical Ecology*.
Hans Knöll Str 8, 07745 Jena, Germany.
[*]Correspondence: amithoefer@ice.mpg.de

As primary producers, autotrophic plants are at the bottom of any food chain. Even earliest land plants were attacked by microbial pathogens and later on by herbivorous animals. Very likely plants and herbivorous insects interact for more than 450 mio years. Over the millennia, plants have evolved a spectrum of defense strategies to drastically reduce insect feeding.

In particular, plants react to insect attack employing an array of direct and indirect defense strategies. As a prerequisite for such appropriate reactions, the perception of insect-derived physical and chemical cues followed by several well-coordinated local and systemic signaling processes are necessary. Relatively little is known about the early signal transduction pathways that connect insect specific signals to plant defense responses they evoke. Ca^{2+}-ions and jasmonate phytohormones have been implicated as key messenger in many plant signaling pathways, and their specific roles in the regulation of defense against herbivory are now better understood. The same holds true for systemic signals that can be detected within the plant.

However, some plant taxa were able to turn the sword around: They became carnivorous. Such plants usually grow in nutrient-poor environments and carnivory has evolved as an additional pathway to supplement nutrients. Thus, plant carnivory involves morphological/anatomical features that are associated with attraction, trapping and killing of prey, followed by its digestion and absorption of the nutrients. Although this is known for almost 150 years, our knowledge concerning the physiology, biochemistry, and molecular biology of carnivory is still limited. Only in recent years, proteome and transcriptome analyses have been started, signaling pathways have been identified. I will present data about prey recognition, signaling, composition of digestive fluids concerning proteins as well as secondary metabolites; finally I will discuss general aspects of the plant carnivorous syndrome with respect to plant defense mechanisms.

Tuesday, October 23 (17:15-18:00 h)

Plasticity in insect olfaction

Sylvia Anton[1*], Christophe Gadenne[1]

[1]*Institute for Genetics, Environment and Plant Protection INRA, Agrocampus Ouest, Université Rennes 1*.
Agrocampus Ouest, 2 rue le Nôtre, 49045 Angers, France.
[*]Correspondence: sylvia.anton@inra.fr

Insects use olfactory cues in many different contexts. Male moths for example use female-emitted sex pheromones to find their mating partners and herbivore insects use plant-emitted volatiles to find their host plants. Herbivores, in addition to emitting volatiles themselves, can induce the production of additional volatiles in their host plants, repulsive to herbivore females, but attracting natural enemies. However, olfactory-guided behaviour to a same volatile signal can change for example with the physiological state and age of the receiving insect, its experience or as a function of additional environmental cues. I will illustrate different forms of olfactory plasticity in two herbivore models and a parasitoid hymenopteran, and show examples of underlying neuronal mechanisms.

We have studied age- and experience-dependent modulation of responses of male moths to female-emitted sex pheromone in the migratory species *Agrotis ipsilon* and how sublethal doses of a neonicotinoid insecticide, clothianidin, influence these responses. Male pheromone sensitivity is up-regulated with age, by experience and curiously also by exposure to low insecticide doses. We have identified the central olfactory system as target for neuromodulation, leading to the different behavioural effects.

In the pea aphid, *Acyrthosiphon pisum*, a species with parthenogenetic reproduction, we compared the role of volatile host plant cues between winged and wingless morphs of the same genotype and searched for anatomical correlates of behavioural differences. Host plant attraction seems to vary between morphs of the same genotype, but also between the same morph of different genotypes.

In the parasitoid *Aphidius ervi*, a generalist species parasitizing different aphid species, we examined the role of experience for the attractiveness of volatiles emitted by host-host plant complexes. Whereas previous studies had found evidence for host-fidelity in this species, our data indicate a combined role of experience and genotype of the parasitoids for olfactory-guided host choice.

Wednesday, October 24 (9:00-9:45 h)

Chemical signaling in insect-microbe symbiosis

Mônica Pupo[1*]

[1]*Laboratory of Microbial Chemistry, School of Pharmaceutical Sciences of RibeirãoPreto, Department of Pharmaceutical Sciences – University of São Paulo.*
São Paulo, Brazil.
[*]Correspondence: mtpupo@fcfrp.usp.brç

Insects and microorganisms establish different types of interspecies interactions, from parasitism to mutualism. Understanding the chemical basis of such interactions can allow us to trait evolution and to discover small molecules with agricultural and biomedical applications. We have special interest in the chemical signaling involved in microbial symbionts of social insects native to Brazil, mainly leaf cutter ants and stingless bees. In this talk, I will present two examples of intricate insect-microbe symbiosis: i) the fascinating example of convergent chemistry in the production of pheromone compounds found in leaf cutter ants and symbiotic bacteria and; ii) the molecular mechanism involved in the fungal-stingless bee mutualism has been deciphered showing the microbial-derived molecule that triggers larval metamorphosis.

Wednesday, October 24 (16:45-17:30 h)

Chemical ecology in and around homes: Semiochemicals used right under our noses

Coby Schal[1*]

[1]*Department of Entomology and Plant Pathology, North Carolina State University.* Raleigh, North Carolina. USA.
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Insects that live in our homes evolved chemosensory adaptations to thrive and thwarttheir primary enemies – you and I!In response to strong selection with insecticidal baits containing glucose as a phagostimulant, populations of the German cockroach have rapidly evolved a novel heritable behavior, aversion of glucose, which is highly adaptive because cockroaches avoid toxic baits. In glucose-averse roaches bitter-responding gustatory receptor neurons acquired a new function – they detect glucose as a bitter compound. We recently discovered other adaptive sensory polymorphisms in the peripheral gustatory system, including fructose aversion. Thus, strong local anthropogenic selection pressures drive polymorphisms in peripheral gustatory function that contribute to the evolution of locally adaptive foraging and sexual behaviors.

The insect cuticular lipid layer is a physical and chemical barrier that excludes pathogens and prevents desiccation. Insects maintain their antennal lipid layer and chemosensory acuity by two counteracting processes: grooming removes excess lipids while fresh lipids are deposited on the antennal surface. These two processes also contribute to fine-tuning of chemosensory acuity by physically removing environmental contaminants, including female contact sex pheromones, which are pervasive in cockroach aggregations. We demonstrate that (a) antennae accumulate more cuticular lipids in the scotophase than in the photophase, (b) when antennal grooming is prevented male antennae become contaminated with female pheromones and their courtship responses significantly decline, and (c) sexual recognition is disrupted as non-groomed males become "feminized" and elicit courtship responses in intact males. Antennal grooming prevents the accumulation of cuticular lipids that interfere with the interaction of semiochemicals with sensory neurons, and it thus prevents adaptation, desensitization and habituation of the male's olfactory system after contact with female sex pheromone, preserving sexual recognition in aggregations.

Thursday, October 25 (9:00-9:45 h)

A journey through the chemical ecology of curculionid beetles

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Curculionidae are beetles of the superfamily Curculionoidea, with about 60,000 species described. Adults of the Curculionidae family are easily recognized by the presence of an extended head in a variable-length rostrum. Many species are important pests of various crops as well as stored grain, and the constant need for more effective and environmentally safe control measures has required the scientific community to seek new control methods to minimize the impact of these insects.

Extensive work has been done on the identification of pheromones and their use within the Curculionidae family, exemplified by the decades of research conducted with the cotton boll weevil, *Anthonomusgrandis*. Following the identification of four components of the aggregation pheromone of *A. grandis*, pheromones of various species of curculionids have been identified.Most pheromones reported in curculionids are produced by males and usually attract both sexes, so they are known as aggregation pheromones.To date, the compounds that make up the pheromones of Curculionidae, basically, correspond to two classes: monoterpenoids (mostly cyclic) and possible fatty acids derivatives (alcohols, ketones, ester, etc).

In the last years, our laboratory has been developing a series of works with insects of the family Curculionidae that culminated in the identification of dozens of molecules. Among these, new chemical structures were identified, as well as a completely different class of pheromones, derived from isophorone. In this talk, the main results we have achieved over the years will be presented and discussed.

Friday, October 26 (9:00-9:45 h)

Exploration of green chemistry for insect pest management: Applications of natural products for biting insect control

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Natural products have been used for their insecticidal and repellent properties for at least two millennia in ancient China, Egypt, and North America (American Indians). Hundreds of studies reporting thousands of plant-derived materials exhibiting repellent and insecticidal properties have been reported in recent years. Nearly all plant-based repellents derived from plant essential oils have limited residual activity. However, there is considerable interest in developing plant-based repellents with greater efficacy and extended residual activity due to increasing regulations and growing negative public perceptions against synthetic repellents and insecticides.

Stable fly (*Stomoxys calcitrans*) has become an economically damaging pest impacting livestock production throughout much of the world (Australia, Africa, Asia, South and North America). Stable flies are capable of developing in substrates composed of fresh decomposing residues of several crop plants including pineapple, coffee pulp, citrus foliage, fruits, vegetables, banana rachis and rice straw. This emerging pest becomes increasingly important with both negative social and economic impacts for dairy and beef farmers including public and political concerns in affected communities. Recent outbreaks of this cosmopolitan pest in Costa Rica have reduced livestock productivity so significantly (to near zero in some countries), with additional mortalities occurred. Environmentally sustainable and cost-effective tools for the management of this pest are not available currently.

In my presentation, I will report our recent findings of medium chain length fatty acids derived from coconut oil that provide strong repellency to four different types of insect vectors (including stable flies). To our knowledge, this is also the first report showing that the longevity and effectiveness of these natural repellent compounds better than the gold standard repellent, DEET against various types of blood-sucking insects. In addition, I will share some info about new attractant compounds identified from various stable fly development substrates that can be used to enhance the mass trapping efficacy. The preliminary results of using the identified attractant and repellent compounds for implementing a novel Push-Pull strategy for controlling biting flies on cattle will also be discussed.

Key words: Natural products, repellents, attractants, biting fly, blood-sucking insects, Push-Pull strategy.

Abstracts of Symposiums

Symposium 1 "Plant – animal interactions"
Tuesday, October 23 (11:15-12:45 h)
Chairs: José Mauricio S. Bento, Cristian A. Villagra

Influence of silicon on plant-insect interactions: Ecological and applied perspectives

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Fertilization with Silicon (Si) has been used in agriculture as a tactic to increase plant resistance against abiotic and biotic stress, such as water deficit, pathogen and insect pests. At first, researchers believed that deposit of Si on leaf epidermal cells provided a mechanical barrier against herbivory. Nevertheless, Si fertilization has been shown to activate biochemical chain events involved in the synthesis of plant defensive compounds against herbivory, including herbivore-induced plant volatiles, which recruit pest natural enemies. This novel piece of information indicates that Si fertilization is a potential tactic for integrated pest management given that deposit of Si in the plant not only increases direct defenses, but can also be used together with biological control. In this context, we have examined Si as an elicitor of direct and indirect plant resistance in grasses, corn and wheat, against chewing and sap-sucking insects, *Spodoptera frugiperda* (JE Smith) (Lepidoptera: Noctuidae) and *Rhopalosiphum padi* (L.) (Hemiptera: Aphididae). We found that Si accumulation in both grasses deterred colonization and establishment by insect herbivores. However, the effect of Si on tritrophic interactions differed depending on the plant species. In wheat, Si accumulation elicited constitutive emission of attractive volatiles to aphid parasitoid, potentially hampering host location. On the other hand, Si accumulation in corn enhanced attractiveness of only herbivore-induced plant volatiles to the minute pirate bug, a predator of neonate caterpillars, what might favor prey location. In this lecture, we will discuss the role of Si on triggering and priming plant induced defenses against insect herbivores. Given that Si is one of the most abundant elements naturally found in soil, it is of great relevance discussing both ecological and applied perspectives.

About the recursive nature of plant pollinator interactions

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Recursion can be defined as the repetition of a process with displacement of the circumstances under which the process takes place. Recursion is an important property of biological processes in general and of biological interactions in particular. Considering the niche of an organism as the part of the medium the organism encounters moment after moment in the realization of its living, each one, plant and pollinator, represent important features of the niche of the other, interacting at the level of species and individuals in a continuously recursive manner. Every new interaction displaces the circumstances under which following interactions will take place. From this it can be said that every new interaction is function of a history of previous interactions and that along their recursive encounters, plants and pollinators change congruently as part of the niche of the other. Considering the recursive nature of plant-pollinator interactions, I propose that a more comprehensive understanding of the biology of plants and pollinators together with insights into the historical contingencies under which the relationships between plants and pollinators develop and persist over time can provide a better understanding about how such relationships evolve. To illustrate the relevance of acknowledging these theoretical aspects I will provide the example of the evolution of flower color in the red poppy, *Papaver rhoeas*. I will show that due to changes in the pigment composition of its petals, populations of this species have differentiated with respect to the UV properties of its flowers. I will then elaborate on the implications of these changes for its interactions with pollinators and on how they influenced a historical shift in the pollination system of *P. rhoeas* that facilitated its spread across Europe.

Inflorescence scent and morphology effect on floral visitor guild of *Haplopappus* (Asteraceae) hybrid zone

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Hybridization is recognized as a promoter of speciation in plants and other lineages. In plants relaying on animal as pollination vectors, interspecific pollen transfer is mediated by the interplay between floral cues and its visitor's foraging responses. Moreover, when hybridization takes place, intermediate hybrid phenotypes may work as phenotypic bridges that may host parental's associated animals. In this work we studied the relationship between inflorescence phenotype and pollinator community composition linked to *Haplopappus* (Asteraceae) species, in the natural hybridization system composed by parentals: *Haplopappus foliosus* and *H. chrysantemifolius* and their resulting hybrid: *H. decurrens* (Asteraceae) at Los Molles, V Region, in coastal central Chile. We measured floral morphology and analyzed floral head scent by GCMS. Moreover we studied if variation in these traits was associated to pollinator species composition in parental and hybrid bushes. Regarding fragrance, we identified 22 compounds, mostly terpenoids such as α-pinene, β-pinene, 1,3,8-p-menthatriene and d-limonene. Main pollination candidates corresponded to native bees, such as *Diadasia chilensis*, *Manuelia gayi* and *Megachile saulcyi* (Hymenoptera). Meanwhile, inflorescences were also visited by parasitic Diptera (*Dioxina chilensis*) and Lepidoptera (*Lioptilodes friasi*). We found differences between host plants both in floral head morphology and VOCs. Furthermore, we discovered that parental *Haplopappus* plants share few common pollinator candidates. Also, we discovered a significant influence of floral head fragrance on visiting species composition. We discuss on the ecological and evolutionary impact of phenotypic hybrid bridges generated by floral scent and hybridization zones on plant-insect interactions.

Keywords: Seed parasites, larcenists, olfaction, NMDS, headspace.

Symposium 2 "Modulation of odor – guided behavior"
Tuesday, October 23 (14:15-15:45 h)
Chair: Pablo Guerenstein

Smelling the past: Insects' olfactory responses can be widely modulated by previous experiences

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Olfaction is probably the most important sensation for insects, as it enables them to detect and identify volatile compounds for feeding, escaping, finding mating partners and identifying suitable oviposition sites, among other processes. Although innate responses are essential for assuring quick responses to evolutionary expected stimuli, experience-dependent behavioral plasticity confers an advantage when unexpected conditions arise. Being rigidly responsive to too many stimuli can be biologically expensive, for what adapting preferences to time-dependent relevant environmental conditions may provide a cheaper and wider behavioral reactivity. Here we describe and analyze how olfactory responses in different pest insects can be modulated by previous chemical experiences.
In the cotton leafworm *Spodoptera littoralis*, male's attraction response to the female's pheromone is not rigid, but instead depends on previous experiences with the same blend or with a sucrose solution. Reciprocally, threshold levels of extension of the proboscis in response to the antenna stimulation with sucrose vary with a pre-exposure with the same compound or with the pheromone. In kissing bugs, the escape response elicited by the alarm pheromone released by disturbed *Triatoma infestans* adults can be widely modulated by associative and non-associative forms of learning. Besides, the olfactory host choice of *Rhodnius prolixus* can be altered by applying aversive associative protocols. Similarly, the aversiveness of bitter compounds for *R. prolixus* can disappear or even change into attraction after non-associative or associative training protocols.
Learning from previous experiences might considerably improve the probability of surviving of any animal, maximizing feeding and copula success and minimizing the probabilities of risk encounters, among other processes. Being pest insects, the experience dependent modulation of behaviour of the here studied insects can seriously bias the efficiency of control and monitoring tools used in the field. Special attention of researches should be focussed in controlling the chemical history of experimental individuals.

Does insect behaviour change as barometric pressure change?

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Recent studies have shown that insects are able to detect sudden barometric pressure changes that generally precede an adverse weather condition. Therefore, the behaviour modification ensures insect survival while dealing with weather oscillations. However, these effects are still poorly known for most species in their different behavioural activities. Here I will present data on barometric pressure effects on insect mating, feeding, oviposition, parasitism and foraging activities.

Preliminary evidence of triatomine host-seeking behavior modulation by a new repellent of bacterial origin

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The host seeking behavior of hematophagous insects is highly associated with the volatile organic compounds (VOCs) released by the host. The attractive and non-attractive role of VOCs produced by bacteria from human skin has been previously shown in the kissing bug *Rhodnius prolixus* (Ortiz *et al.* 2011, Tabares *et al.* 2018).
The aim of this study was to assess the behavioral responses of *R. prolixus* and *Triatoma infestans* to previously identified VOCs produced *in vitro* by non-attractive bacterial species, isolated from human skin. Using an exposure device, we evaluate the repellency effect of three compounds, at different concentrations, by quantifying both, the time spent in the host proximity and the number of proboscis extension reflex (PER). These results were compared with the control (e.g. host without the presence of the repellent compound) and the gold standard DEET. Additionally, a capture olfactometer were used to assess the percentage of total captures and oriented captures of *Rhodnius prolixus* in the presence of one of the repellent compounds during a whole night test.
In the presence of one of the compounds, *Rhodnius prolixus* and *Triatoma infestans* significantly reduces the time spent in the host proximity as well as the number of PER. The concentration at which the same repellent effect is achieve is around ninety times lower than DEET. In the same way, the percentage of total captures and oriented captures in the presence of the tested compound were lower than the control experiment for *Rhodnius prolixus*.
The behavioral evidence presented here reinforces the idea that VOCs produced by bacteria can modulate the host seeking behavior of *R. prolixus* and *T. infestans*. Future efforts should be oriented to evaluate these compounds in field tests.

Ortiz MI, Suarez-Rivillas A, Molina J. (2011) Behavioural responses to human skin extracts and antennal phenotypes of sylvatic first filial generation and long rearing laboratory colony *Rhodnius prolixus*. Memorias Instituto Oswaldo Cruz. 106(4):461-466.
Tabares M, Ortiz M, Gonzalez M, Carazzone C, Vives Florez MJ, Molina J (2018) Behavioral responses of *Rhodnius prolixus* to volatile organic compounds released *in vitro* by bacteria isolated from human facial skin. PLoS Neglected Tropical Diseases.

12(4): e0006423.

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How resistance to transgenic crops affects the reproduction of a moth: case of *Spodoptera frugiperda*

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There are many studies demonstrating that the development of resistance to insecticides comes at a cost, reflected in traits such as extended larval developmental time, small adults and reduced fecundity. In contrast, while very few studies have examined the possibility of resistance might affect pheromone communication systems they have all reported some differences in the pheromone biology of resistant and susceptible individuals. In Brazil the fall armyworm has developed resistance to *Bt* so we tested the hypothesis that the development of resistance impacts female calling behavior, with the prediction that resistant virgin females would call less than susceptible individuals. Contrary to our expectations resistant females spent significantly more time calling that susceptible ones suggesting that there is no cost reflected in calling duration. Interestingly, this would support the results of a parallel study that found no differences in various growth parameters of susceptible and resistant individuals. Experiments are examining both pheromone emission and male responses for unless there are marked changes in the pheromone blend and/or the rate emission then with the extended calling window resistant females would have a higher probability of attracting mates. These finding will be discussed within the context of resistance management when using Bt corn as part of a pest management program.

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Effects of the ambient CO_2 level on the neurophysiology and behavior of lepidopterans

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As other insects, lepidopterans use their olfactory system to accomplish different tasks during their life cycle, including searching for a mate and for a food source. To detect odors they possess a variety of olfactory receptor neuron types, including receptors tuned to sense ambient CO_2. It has been suggested that for lepidopterans CO_2 would be one of the cues used during foraging. Surprisingly, CO_2 receptor neurons are located on a mouthpart, the labial palp, and not on the antenna as it would be expected. Also, surprisingly, those sensory neurons project into the antennal lobe of the brain, which is the primary olfactory information processing center, to which antennal olfactory receptor neurons project. Therefore, it is conceivable that at the level of antennal lobe, integration of information about general odors and about ambient CO_2 occurs. Using multichannel recording techniques, we explored possible modulatory effects of ambient CO_2 levels on the olfactory neurophysiology of adult lepidopterans (including *Spodoptera frugiperda*). Our results suggest that different modulatory phenomena occur at the level of antennal lobe: the ambient CO_2 level appears to modulate responses to odors (especially floral odors) in diverse ways. We also investigated behavioral effects in a wind tunnel and found that high levels of ambient CO_2 (i.e., 900 ppm) interfere with sex pheromone orientation in male *S. frugiperda*. Our results suggest that the predicted rise in ambient CO_2 levels, as part of the ongoing global climate change, will affect the physiology of the insect brain, in particular at the level of antennal lobe. We also suggest that the general olfactory behavior will also be affected.

Symposium 3 "Molecular and neurobiological bases of chemoreception"
Wednesday, October 24 (11:15-12:45 h)
Chair: Romina B Barrozo

Some salt, not too much… how to solve this sensory complexity with the same gustatory receptors?

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In all organisms, salts produce either appetitive or aversive responses depending on the concentration. While low-salt concentration in food elicits positive responses to ingest, high-salt triggers aversion. Because salts are essential nutrients, their detection is crucial. Salts such as sodium chloride participate in vital physiological functions maintaining the internal homeostasis and neuronal transmission. Feeding on deficient or excessive salt sources could drive animals to physiological disorders. The taste sense helps animals to evaluate the quality of food, favoring the ingestion of nutrients and avoiding the consumption of harmful or toxic compounds. Taste is then tuned to accept adequate concentrations of salts, according to each animal's necessity. In this way, "tasteful" usually matches with "low" salt concentrations in food, and "distasteful" with "high" salt concentrations.
Still the mechanisms involved in this dual behavior have just started to be uncovered in some organisms. In *Rhodnius prolixus*, using pharmacological, electrophysiological and behavioral assays, we demonstrated that upon high-salt detection in food a nitric oxide (NO) dependent cascade is activated. This activation involves a soluble guanylate cyclase (sGC) and the production of cyclic guanosine monophosphate (cGMP). Thus, appetitive responses to low-salt diets turn to aversion whenever this cascade is activated. Conversely, insects feed over aversive high-salt solutions when it is blocked by reducing NO levels or by affecting the sGC activity. The activation of NO/sGC/cGMP cascade commands the avoidance feeding behavior in *R. prolixus.* Thus, we propose that the dual behavior to salts is just the result of the activation or not of a NO/sGC/cGMP cascade. Investigations in other insect species should examine the possibility that high-salt aversion is mediated by NO/sSG/cGMP signaling.

Antennal expression profile of the sensory gene repertoire of *Triatoma infestans* after blood-feeding

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Triatoma infestans is the main vector of *Trypanosoma cruzi*, the etiological agent of Chagas disease. This species was reported in Argentina, Bolivia, Brazil, Chile and Uruguay, the latter two having been declared free from it. Control failures in Argentina and Bolivia have promoted the selection of resistant populations of this species. As a consequence, the success of bug control programs in both countries is limited. Insect control methods based on behavioral manipulation are deemed both environmentally friendly and sustainable. Behavioral state-dependency is a process through which insects tend to show altered responsiveness to sensory cues depending on development or nutritional status. Its physiological and molecular bases are not clear. Knowledge on the molecular bases of behavior and sensory physiology has developed due to the advent of NGS techniques. We sequenced the antennal transcriptome of *T. infestans* in order to characterize the set of expressed genes. Gene expression profiles found in the antennae of unfed and fed insects were compared. Experimental insects were 5th instar larvae from the Centro de Referencia de Vectores (Cordoba – Argentina). Antennae (20 *per* sample) were collected from 34 day-old 5th instar larvae fed 4 days before excision (6 replicates *per* condition) and used for total RNA extraction and RNA-Seq library preparation (Illumina NovaSeq6000 sequencing, 150 bp paired-end reads, 20 million reads *per* sample). Raw read quality was evaluated with FastQC, cleaning and trimming done with Trimmomatic V.0.32. An antennal assembly was performed with Trinity V. 2.8.4 and its completeness assessed using BUSCO v3. Chemosensory receptor candidates (as well as other relevant sensory-related gene families) were identified in the *T. infestans* assembly using *R. prolixus* sequences. Salmon V.0.10.2 was used to determine transcript abundance and EdgeR to detect differentially expressed genes. The estimated coverage of our antennal transcriptome was 97.7% of an Arthropoda database. Assembly rendered 138941 transcripts, with N50 value=1509 and average length 429 bp. More than 77% of reads mapped against our assembly in all samples. BLASTn searches detected transcripts of many sensory gene families, a preliminary list including 26 IR, 13 GR, 19 OBP, 18 CSP, 12 TRP, three SNMP, three ammonium transporter, three mechanoreceptor, 13 CYP4, 14 CYP3 and six PPK candidates. Our preliminary list includes 30 OR candidates, but based on evidence from the genome of *R. prolixus*, we expect this to be expanded through iterative searches. An expanded number of IR75 paralogues seems to present a similar case compared to what has been reported for *R. prolixus*, supporting the suggested relevance of this IR subfamily for triatomines. Besides, we report the antennal expression of a broad set of neuropeptides as previously found for *R. prolixus*. A set 919 transcripts showed significantly different antennal expression (FDR <0.05) between unfed and fed bugs, being 557 of the down-regulated (LogFC < -2) and 362 up-regulated (LogFC >2). This set of genes showing significantly altered expression after feeding includes representatives of diverse sensory gene families. The relevance of these results will be

discussed under the perspective of the known behavioral state-dependency induced by blood feeding.
Funding by CNPq, FAPEMIG, INCT-EM, CONICET, ANPCYT and FIOCRUZ.

Age-dependent regulation of host seeking in mosquitoes

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Behavioural attraction of the yellow fever mosquito, *Aedes aegypti*, and themalaria vector *Anopheles coluzzii* to human host odour gradually increases during adult maturation. Elucidating the molecular basis of this age-dependent plasticitycould reveal novel targets for vector control. In previous studies, we and others have demonstrated that the onset of host seeking in both species coincides with an increased sensitivity of olfactory sensory neurons and the abundance of chemosensory receptor genes expressed in the maxillary palp. During my talk, I will present data on the functional characterisation of the near-complete repertoire of odorant receptors (Ors) expressed in the antenna of *Anopheles coluzzii*, to fractioned human odour. When presented as a blend in their ratio of natural emission, the identified bioactive odorants elicit attraction by host-seeking mosquitoes, emphasising that Ors alone can mediate this behaviour. Interestingly, the same blend inhibits attraction in teneral mosquitoes. This switch in behavioural response indicates a change in valence during adult maturation. Quantitative analysis of *Or* transcript abundance and *in vivo* electrophysiological analysis reveal that the olfactory system of female *Anopheles coluzzii* undergoes concerted changes that correlate with the onset of host seeking. A similar mechanism is likely regulating the host-seeking behaviour of *Aedes aegypti*.

Aedes aegypti mosquitoes use the IR8aolfactory receptor pathway to detect human odor

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Mosquitoes use olfaction as a primary means of detecting their hosts. Previously, the genetic ablation of a family of *Aedes aegypti* olfactory receptors, the Odorant Receptors (ORs), was not sufficient to reduce host-seeking in the presence of carbon dioxide (CO_2). This suggests the olfactory receptors that remain, such as the Ionotropic Receptors (IRs), could play a significant role in host detection. To test this, we disrupted the *Ir8a* co-receptor in *Aedes aegypti* using CRISPR/Cas9. *Ir8a* mutant mosquitoes lack odor-evoked responses to acidic volatiles that are components of human odor. *Ir8a* mutant mosquitoes are not attracted to lactic acid, a behaviorally active component of human odor. These mutants have significant reductions in host seeking when exposed to humans or human odor and act with the CO_2-detection and OR pathways in host detection. Our study reveals that the IR8a co-receptor is crucial for an anthropophilic vector mosquito to effectively host seek.

Symposium 4 "Chemical ecology of disease vectors"
Wednesday, October 24 (14:15-15:45 h)
Chairs: Álvaro Eiras, Marcelo Lorenzo

Synthetic attractants for monitoring host-seeking anophelines

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Over the past 15 years, there have been declines of more than 50% in malaria cases worldwide. However, in many low and middle-income endemic areas, malaria still remains a major public health challenge. Improved vector surveillance tools are needed to monitor epidemiological trends and, so far, there is no method more effective than the human landing catch (HLC). However, due to ethical issues given the individual's exposure and the risk of contracting pathogens, the development of new methodologies for sampling anophelines is required. Therefore, synthetic attractants, developed through a process of analysing the attractiveness of volatiles produced by humans, appear to offer better and safer alternatives. Important advances in the development of odour blends for attracting mosquitoes are being achieved and one of the most promising is the synthetic attractant developed at Ifakara Health Institute, Ifakara Blend (IB), which was demonstrated to be more attractive than humans at medium to long range. The use of the IB and other synthetic attractant variants are being studied for sampling malaria vectors in Brazil and Tanzania. Furthermore, in addition to having a good attractant, the performance of the IB dispensed by different devices, including a polymer-based recently developed by our group at UFMG, are also being evaluated. The findings suggests that the use of synthetic attractants that mimic human odours are a potential alternative for HLC as a sampling tool for host-seeking anophelines, and its efficacy can be optimized by selecting appropriate odour-dispensing systems.

Acknowledgments: CAPES, CNPq, FAPEMIG, Ifakara Health Institute.

Responses of central olfactory neurons: Looking for an odor blend to attract triatomines

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Chagas disease still remains as an important vector-borne neglected tropical disease. In the absence of an effective treatment for chronic human infection or vaccines, the prevention of vector-borne transmission of Chagas disease in endemic areas relies on suppressing house infestations by triatomine bugs. *Triatoma infestans* is the main triatomine vector species in the southern cone countries of South America. We aim at developing an efficient host-based odor blend attractant to be used as a lure in a trap to monitor triatomines. In insects, odorants are detected by olfactory receptor cells (ORCs) mainly on the antenna. Insect ORCs project to the antennal lobe (AL) in the brain. The AL is the first information-processing center of the olfactory system. It is known that odor mixtures are more attractive than single odorants. In order to understand how information about potentially attractive odor mixtures is processed in the triatomine brain, and to speed up the development of such attractive blends it is necessary to study the responses of AL neurons to single odorants and mixtures of them. Although some information about the odor tuning and physiology of the triatomine ORCs is available, nothing is known about how odor information is processed in the triatomine AL. Using a multichannel recording technique we recorded the activity of neurons in the AL of *T. infestans* nymphs upon stimulation with synthetic odorants. Responses to a number of synthetic odorants or their mixtures were also obtained. Those synthetic odorants included □-pinene, valeric acid, 1-octen-3-ol, nonanal, isobutyric acid, isobutilamine, and ammonia. Response types included cessation of spikes (hereafter inhibition), excitation, inhibition-excitation and excitation-inhibition. Dose-dependent responses to synthetic odorants were found. However, surprisingly, in several cases lower concentrations of odorants evoked higher responses than higher concentrations. Moreover, the response to a single odorant could be opposite (i.e., excitation vs. inhibition) depending on the odorant concentration.

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Salt perception in a hematophagous insect: Linking peripheral detection to behavior

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Animals identify nutrients and avoid toxins with the aid of the taste sense. Salts are unique because depending on concentration produce opposite behaviors. Low-salt concentration triggers feeding, whereas, high-salt concentration turns an appetitive behavior into aversive. Salts are main components of blood, and could serve as gustatory cues to blood-sucking insects. Recently, we showed in the hematophagous kissing bug *Rhodnius prolixus*, that ingestion is facilitated or prevented depending on salt concentration of the feeding solution. However, once posed over the selected host and before feeding, probably *Rhodnius* do a gustatory evaluation of the host skin. Consequently, insects decide whether to bite or not. Whether blood feeders can evaluate components of the host skin or not is still unknown. In this work, we investigated if *Rhodnius* detect salts before biting and if this detection could affect their feeding decisions. Besides, we analyzed if DEG/ENaC channels or *PPK*s could play a role in salt sensing. Through morphological and electrophysiological approaches, we found gustatory antennal sensilla that house two gustatory receptor neurons tuned to NaCl and KCl. Using bioinformatics tools and phylogenetic analysis we identified two genes, Rproppk28 and Rproppk19, homologous to two *DrosophilaPPKs* relevant in water and salt detection. Moreover, we showed that these two *PPKs* are expressed in *Rhodnius* antennae. Finally, we analyzed the functional role of Rproppk28 and Rproppk19 in salt sensing by means of gene silencing through RNA interference. Knockdowned insects exhibited a significantly reduced levels of these transcripts and were unable to detect salts. Our results confirm the importance of the these two PPKs in the salt detection in *Rhodnius*, and show the relevant role of the gustatory system in a blood-sucking insect.

Effect of mosquito age, experience and infection status on DEET efficacy in the malaria mosquito *Anopheles gambiae s.s.*

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Mosquito-borne diseases are major public health concerns, and their control is threatened by the spread of insecticide resistance in vector populations. In this context, the use of repellents is an alternative strategy to limit mosquito-host interactions. However, mosquito physiological condition is thought to affect their efficacy. Particularly, experience, age and infection status are of great epidemiological interest, and have been rarely investigated. Yet, as mosquitoes get infected during blood feeding, infectious mosquitoes are expected to have experienced at least one contact with a repellent in areas of high repellents coverage. Also, the extrinsic incubation period of some pathogens is relatively long, which means that old mosquitoes are the most susceptible to be infectious. Finally, mosquito infection can influence olfactory perception or behavior. In this context, the efficacy of the DEET repellent against experienced, old, and infectious malaria mosquitoes *Anopheles gambiae ss* females was evaluated. Three independent experiments were performed. First, we evaluated whether a first blood meal successfully obtained upon a DEET–treated net would influence the success at taking a second blood meal in spite of DEET. Then, we compared inhibition by DEET between mosquitoes aged of 4, 11 and 18 days. Finally, we evaluated DEET inhibition in uninfected mosquitoes and in mosquitoes infected at different developmental stages of *P. falciparum*. Results reveal complex interactions between mosquito physiological condition and repellents efficacy, with for instance no effect of a prior exposure to DEET on its efficacy at the second exposure, but a strong increase in DEET efficacy with mosquito aging. Our results give insights to understand the mode of action of the most used mosquito repellent. They also could have significant epidemiological consequences for vector control and may help public health policies in designing protection tools that specifically target mosquitoes that are the most susceptible to transmit pathogens.

Symposium 5 "Identification and synthesis of semiochemicals"
Thursday, October 25 (11:15-12:45 h)
Chair: Paulo Zarbin

Chemical ecology of insect pests associated to Yerba Mate (*Ilex paraquariensis*)

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Yerba mate (*Ilex paraguariensis*, St. Hil., Aquifoliaceae) occurs naturally in Argentina, Brazil, Paraguay and Uruguay and is important socially and economically to those countries. Leaves of yerba mate tree are used to produce one of the most popular teas of South America, known by different names (yerba mate, mate, chimarrão or tereré) depending on the region of cultivation and preparation method. Yerba mate cultivation is associated to a complex of insect pests that are responsible for high financial losses. Among several species, *Hedyphates betulinus* (Coleoptera: Cerambycidae), *Thelosia camina* (Lepidoptera: Bombycidae), and *Gyropsylla spegazziniana* (Hemiptera: Psylloidea) are classified as the main pests for yerba mate cultivation and are a target of study in our research group since the past decade. An overview of the chemical communication of these species will be discussed in this presentation. *H. betulinus* sex communication is mediated by male-produced long-range pheromones and by contact sex pheromones produced by females. The lepidopteran *T. camina* sex communication is mediated by a mixture of unprecedented type I lepidopteran pheromones. The bouquet of volatile organic compounds produced by *I. paraguariensis* is affected after herbivory of both *H. betulinus* and *T. camina*. Furthermore, *H. betulinus* herbivory is distinctive from the other treatments, inducing a distinctive pattern of emission of terpenes. Initial experiments regarding the sex communication of the psylid *G. spegazziniana*, indicate the emission of a female-specific ketone which is used as a sex pheromone.

Identification and synthesis of pheromones from agricultural and forestry pest insects in Chile

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Agricultural and forestry activities are important pillars of Chilean economy. The production, however, is threatened by a number of diseases and pests, among which arthropods, particularly insects, can cause considerable damage to crops. In the past decades, in the search for alternative pest management methods, pheromones have been incorporated in pest management programs of many insect species worldwide. In order to contribute to the development of alternative pest management methods for pest insects present in Chile, our research group has identified the pheromones of several native and cosmopolitan insects, among them, *Pseudococcus calceolariae* (Hemiptera: Pseudococcidae), *Proeulia auraria* and *P. triquetra* (Lepdoptera: Tortricidae), *Chilecomadia valdiviana* (Lepidoptera: Cossidae), and *Leucoptera sinuella* (Lepidoptera: Lyonetiidae). In this presentation, the different approaches used in the identification and syntheses of the respective pheromones will be presented and compared. Perspectives on the development of applications in pest management for the pheromones will be briefly discussed.

Synthesis of pheromone for insect control

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There are several concerns about pesticides use in insect control. Since the seventies and eighties, the concept and practice of integrated pest management (IPM) strategies have evolved with the trend of reducing pesticide use. Indeed, pesticides were largely reported to induce human diseases and to be harmful for the environment. The success of pest control through pesticides is limited due to a series of reasons: (a) pesticides are very expensive compared to the crop losses avoided; (b) generally pesticides are non-species-specific and can cause damages in beneficial insects; (c) many pests develop resistance towards chemical treatments; (d) pesticides are recognised to be unsafe for environment and human health. In general, synthetic pheromones are used in IPM, being selective and safe. Several improvements have been obtained in this area and slow-release devices have been developed, however, the bottleneck of the area continues to be the long and expensive syntheses, once only low quantities of compounds are needed, compromising prices. Hundreds of pheromone compositions are now available, obtained through diverse synthetical methodologies. Pheromones and para-pheromones are multifunctional compounds: saturated and unsaturated, chiral and achiral, cyclic and acyclic. In their syntheses, the challenge is to obtain the products with the adequate chemical and stereochemical purities, especially concerning unsaturated compounds. Several methodologies are available for the double bond synthesis, including the Grubbs Reaction, Wittig reaction. In the present work, we will discuss synthetic approaches to the production of pheromones, in scale useful for pest management.

Symposium 6 "Semiochemicals and pest management"
Friday, October 26 (11:15-12:45 h)
Chair: Andrés González

Panel and multiple-funnel intercept trap performance varies among taxa: Why?

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The success of insect detection and monitoring programs is affected by many variables, some of which are under program control and many others that are not. Primary to program success is knowledge about how and why trap effectiveness varies among target taxa and habitats. Currently, decisions about trap type are informed by experience and/or research results, which may or may not have wide applicability amongst taxa. Our study objectives were to: 1) compare the performance of Semiochemical-baited intercept panel and multiple-funnel traps for forest Coleoptera, with an emphasis on Cerambycidae; 2) test if semiochemical-baited intercept panel and multiple-funnel traps sample the same communities of forest Coleoptera; and 3) using a walk-in flight-tunnel and CO2 as a surrogate gas for pheromone, characterize differences in plume structure among different intercept trap designs. Analyses of the results of these trials suggest that panel traps outperform multiple-funnel traps, intercept panel and multiple-funnel traps sample different communities of forest Coleoptera and although plume structure differs among intercept trap designs it does not differ between panel and multiple-funnel traps.

Use of pheromones for the management of mealybugs (Hemiptera: Pseudococidae) in fruit crops

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Mealybugs (Hemiptera: Pseudococcidae) are important pests of fruit crops in many regions of the world. In the last decade the sex pheromones of many species have been identified and synthetized. We have investigated their use in mealybug management in fruit crops, with the aims of detection, phenology and abundance monitoring, and for control through mating disruption or mass trapping.

Field experiments in several fruit crops have been carried out for the three main mealybug species regarding detection and monitoring, and for *Pseudococcus calceolarie* for control. Pheromones show a great specificity in field conditions, which make then effective tools for detection. The effective range of pheromone traps depends on dose; thus, dose and placement are important in order to detect within field or plot populations. There no consistent pattern between male captures and population observations, therefore its usefulness for monitoring phenology deserves more investigation. We found significant positive correlations between *P. calceolariae* and *P. viburni* males caught in pheromone traps with female abundance and fruit infestation at harvest.

Male trap captures in apples plots with and without pheromones using a SPLAT formulation, showed that males captures significantly decreased after placing the disruption treatment, and were significantly less than in the control plots. Mass trapping experiments with *P. calceolariae* showed a significant removal of males, but populations within the season were similar to the plots without mass trapping.

Our results show the potential of mealybugs pheromones for detection, population abundance monitoring and control at field level, and further research are needed to define the operational details under commercial conditions. Funding: FONDEF D10I1208 & FIA PYT-2017-0140.

Semiochemicals for the management of *Lobesia botrana* (Lepidoptera: Tortricidae) in Chile

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The European grapevine moth, Lobesia botrana (Lepidoptera: Tortricidae), is an invasive pest present in Chile since 2008. This pest is widely distributed from Atacama to Araucanía Regions using grapevine (Vitis vinifera), blueberries (Vaccinium spp) and plums (Prunus domestica and P. salicina) as cultivated host-plants. At present, this pest is under an official control program directed by the Servicio Agrícola y Ganadero (SAG).

The control program includes monitoring with sex pheromone traps, control with authorized insecticides and mating disruption, in order to reduce the abundance and distribution of this pest. During the last decade field experiments have evaluated the efficacy of different mating disruption technologies, which are currently used in an area-wide program including nearly 80.000 ha during the 2018-2019 season. Reduction of trap catches and pest densities in cultivated areas are the main results of this program, but this produce difficulties for testing new mating disruption products. New field experiments with cages and laboratory reared moths are under development. Similarly, the continuous increase in the mating disruption area interferes with pest monitoring using sex pheromone traps. New male and female attractants based on volatiles from fermentation of grapevine fruits is under development with encouraging results. Among them, acetic acid, 2-phenyl ethanol and other volatiles from yeast fermentation have shown significant male and female attraction in vineyards under mating disruption. Future development of combo lures with sex pheromone and other alelochemicals is promising for monitoring this pest.

Mating disruption of native leafrollers: A supplementary management tool for pheromone-based control of primary Orchard pests

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Pheromone-based mating disruption (MD) of primary orchard pests, such as the codling moth (CM) and the oriental fruit moth (OFM), has been successfully implemented in many countries, and has greatly expanded in South America. In Uruguay, more than 80% of the apple and pear area is currently included in an area-wide MD program for CM and OFM. However, with fewer or no insecticide applications for these moths, secondary pests such as native leafrollers may become serious pests in MD-managed orchards. Two native leafrollers commonly found in Uruguay and southern Brazil, Bonagota salubricola and Argyrotaenia sphaleropa, often require several insecticide applications, hence diminishing the benefits of MD with regards to insecticide use. The pheromones of these leafrollers have been identified several years ago, and have been extensively used for population monitoring, but so far attempts for mating disruption have been unsuccessful for B. salubricola, and not attempted for A. sphaleropa. Here we report results of the first season of a simultaneous MD-trial for these two leafroller species, conducted in a 4-ha commercial apple orchard. Rope dispensers were provided by Shin-Etsu (Japan), containing E3,Z5-dodecenyl acetate, Z5-dodecenyl acetate and Z9-hexadecenyl acetate for B. salubricola, and Z11,13-tetradecenyl acetate, Z11-tetradecenyl acetate and Z11,13-tetradecenal for A. sphaleropa. Five-hundred dispensers were installed per hectare for each species, in alternate trees, just after the first adult flight in early spring. Male captures were evaluated with delta traps throughout the season, and fruit damage was scored weekly and at harvest. A 4-há plot, similar in all aspects to the experimental plot and located 200 m up-wind, was left untreated as control. As a result of the mating disruption treatment, monitoring trap shut down was almost 100% for both species in the treatment plot, while captures in the control plot oscillated throughout the season and even exceeded control thresholds. Fruit damage in the MD-treated plot was, on average, less than 1%, with no chemical treatment for leafrollers. In the control plots, an application of methoxyfenozide for leafrollers was needed when trap captures exceeded the threshold.

Abstracts of Oral Presentations

Oral Presentations 1
Tuesday, October 23 (16:15-17:15 h)
Chair: Nancy Barreto

O-01 Sexual pheromone influence on vibratory communication of the Neotropical brown stink bug, *Euschistus heros* (F.) (Hemiptera: Pentatomidae)

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Interaction between signals from different channels could be decisive for satisfactory information interchange during insect communication. During the reproductive behaviour, stinkbug communicate by chemical and physical signals as pheromone, chemical traces and substrate-bone vibrations. In this work we evaluated how sexual pheromone can affect vibratory communication during the mating behaviour of *Euschistus heros*. Experiments were performed using plants and a paper loaded with 5 µL of male pheromone extract, and as control, plants and a paper loaded with 5 µL of hexane. Tests were performed placing 30 couples, one single male or one single female on different leaves of a plant (N= 30). The sexual behaviour and vibratory signal emission of insects were monitored for 20 minutes. There was no difference on couple behaviour (time until mate and number of mates) between pheromone and control exposure. In the experiments using a single insect, females took less time to trigger vibratory signals and had higher number of buzzing wings when exposed to pheromone compared to control; however, there was no difference on the number of emitted pulses. Males showed no behavioural difference (percussion, time to answer, number of pulses and buzzing) between pheromone and control exposure. Comparing the male and female behaviour, males took more time to trigger a signal and produced less buzzing signals on control, showing that pheromone presence can stimulate females to produce vibrational signals. To evaluate if vibrational signals can interfere on males pheromone released rate, experiments with SPME fibre to capture the volatiles and GC-MS analysis are currently underway.

O-02 This work is not presented

O-03 Sapogenins of quinoa (*Chenopodium quinoa* Willd.) genotypes as sources for improved insect resistance

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The cultivation of quinoa is receiving growing worldwide interest for its nutritional quality for human consumption and its adaptability to abiotic stress. However, the interaction between quinoa genotypes and its insect herbivores has received less attention. Quinoa is characterized by containing saponins, which have general cytotoxic, antifungal and anti-insect properties. Nonetheless, there are different structures of the saponin aglycones, including oleanolic acid, hederagenin, phytolaccagenic acid, and serjanic acid. The relative composition of sapogenins and their biological properties may differ among the genotypes grown in Chile, as there is great variation in their geographical origin, ranging between 19° and 42° latitude South (LS). Hence, it is possible that there is diversity in their sapogenin content and derived ecological functions regarding their interaction with insect pests. The present work advances our results regarding the identification and quantification of sapogenins in four Chilean quinoa genotypes (originated from Ancovinto (19°LS), Cahuil (34°LS), Chillán (36°LS) and Chiloé (42°LS)) and one commercial variety (Regalona). To determine genotypic effects on sapogenin expression, all genotypes were grown under the same environmental conditions. HPLC and GC-MS analysis indicated that the total concentration of sapogenins was similar among genotypes, but the relative proportion of specific compounds varied as a function of the latitudinal origin of the genotypes. Interestingly, Oleanolic acid concentration was highest in the northern genotype, but it was the lowest in the most southern genotype. The opposite relationship was determined for Hederagenin, which content was the lowest in the northern genotype, but its concentration was highest in the southern genotype. This results are novel and will be complemented with ongoing studies on host plant resistance against Lepidoptera species.
Research funds provided by PUC VRI II160018.

O-04 Chemical profile of the volatile compounds of *Baccharis salicifolia* (Asteraceae) and interaction with *Macrodactylus nigripes* (Coleoptera: Melolonthidae)

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Plant volatiles are infochemicals based on complex mixture of a wide variety of organic compounds. These volatiles have important biological functions and they are also involved in various interactions, which have been cited in chemical-ecology context for species of Melolonthidae. In this study, the interaction between adults of "rose chafers" *Macrodactylus nigripes* Bates (Coleoptera: Melolonthidae) and "seep willow" shrub *Baccharis salicifolia* (Ruíz & Pavón, Asteraceae) was recorded and the leaves volatiles of seep willow that might be involved in the attraction of these insects were extracted and identified.
Behaviour records were performed by means of direct observation. We conducted a total of twenty-four observational sessions and recorded and described the movements, actions and positions of adults of *M. nigripes*.
Leaves of *B. salicifolia* was collected in Tlaxcala, Mexico during the flight time of insects. The volatile compounds were captured by solid phase microextraction (SPME) and analysed by gas cromatography coupled to mass spectrometry (GCMS).
We found five behaviour patterns in the interaction between *M. nigripes* and *B. salicifolia* with a pattern that only occurs in females.
Fifteen volatile compounds were identified in leaves of *B. salicifolia*, the most abundant chemicals were α-pinene, trimethylindan and cyclohexylbenzene.
Volatile compounds of *B. salicifolia* could be involved in the selection of the host plant by *M. nigripes*. These compounds have been previously reported in other plant species, including some species considered as host plants for Melolonthidae. Future studies should be focused in the evaluation of biological activity of α-pinene, trimethylindan and cyclohexylbenzene, with olfactometer and electroantennography bioassays.

Oral Presentations 1I
Wednesday, October 24 (9:45-10:45 h)
Chair: Alicia Lorenzo

O-05 Blend of oviposition-attracting larval holding water compounds as control strategy for *Aedes aegypti* (Diptera: Culicidae)

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Aedes aegypti (L.) is the vector of dengue, chikungunya, Zika and yellow fever. Chemical factors involved in the selection of the oviposition site by mosquitoes have become a focus of interest in recent years, and considerable attention has been paid to the chemical signals that influence this process. Previous work of our laboratory evaluated the conspecific competition in this species, observing a highstimulation of oviposition in containers containing larvae compared to those without them. With the objective of analyzing the olfactory signals, which may modify the oviposition behavior of *Ae. aegypti* in presence of larvae, a qualitative analysis of the compounds present in the water which previously contained larvae was carried out using a liquid-liquid extraction technique and subsequent GS-MS analysis.

Then, oviposition behavior of different binary blends of larval holding water compounds, including dodecanoic acid, in combination with the *n*-heneicosane (an oviposition pheromone of *Aedes aegypti*) were evaluated. The binary combinations tested were (pheromone: acid), 1: 1, 1:10 and 1: 100. Voile cages were used with a binary choice test and 15 gravid females were allowed to choose between a control substrate (solvent) and a treated substrate (blend). The responses were analyzed through the oviposition activity index (OAI) = (Nt-Nc) / (Nt + Nc), where Nt is the average number of eggs placed in the treated water and Nc the average number of eggs placed in the control of water. Fifteen different compounds: dodecanoic acid, tetradecanoic acid, hexadecanoic acid, and various long chain hydrocarbons (C_{20}-C_{30}) were identified from the larval holding water. According to our results, higher OAI values for the 1:10 and 1: 1 combination were obtained compared to the individual components.

New blends of oviposition attractants can be used as part of integrated vector management through their application into lethal ovitraps attracting the females to oviposit in these ovitramps inhibiting the emergence of new generations.

O-06 Biological Activities of Natural Abenquines and Their Synthetic Analogues

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Abenquines are natural products that belong to a class of quinoid compounds, bearing natural amino acids residues and a*N*-acetyl moiety (Figure 1). These compounds were isolated in 2011 from the fermentation broth of a *Streptomyces* sp. found in the Chilean highland of the Atacama Desert, and were shown to possess only mild inhibitory properties against bacteria, dermatophytic fungi and phosphodiesterase type 4b.

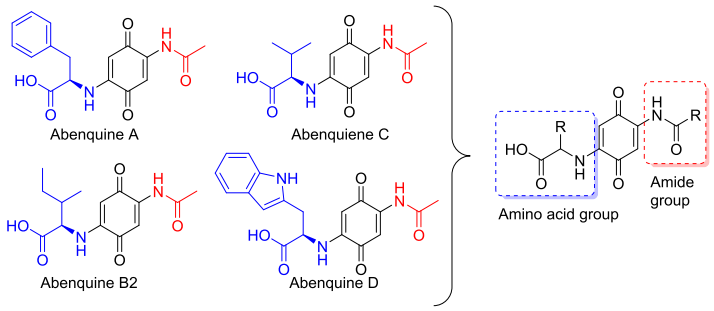

Figure 1. Structure of naturally occurring abenquines.

Aiming to use natural products for the development of bioactive substance with an application as pharmaceutical or agrochemical, we further investigated the potential of abenquines and their analogues.Abenquines has been achieved in three steps starting from 2,5-dimethoxyaniline, with overall yields of 41–61%. Abenquine scaffold was used to design a series of analogues where the amino acid residues were replaced bydifferent aliphatic amines. We prepared analogues bearing the amino acid fragment and the acyl moiety was changed by the benzoyl group,resulting in 11 new analogues ofabenquines and evaluatedfor their potential as algicidal, showing the ability to inhibit cyanobacterial growth in the 1 to 100 µM range. Thetwo most effective analogues were able to inhibit the proliferation of five cyanobacterial strains, with IC_{50} values ranging from 0.3 to 3 µM. Aiming to exploit the abenquine scaffold as a model for the synthesis of new herbicides targeting photosynthesis, 14 new analogues were prepared by replacing the amino acid residue with benzylamines and the acetyl with different acyl groups. Four analogues showed high effectiveness (IC_{50} = 0.1-0.4 µM), comparable with the commercial herbicide diuron (IC_{50} = 0.3 µM). The data suggest that this class of compounds interfere at the reducing side of photosystem II, having protein D1 as the most probable target.This class of compounds presents strong activity against different human cancer cell lines. Therefore, these substances appear as promising tools for different potential activities.

O-07 This work is not presented

O-08 Quinocyclines from *Micromonospora tulbaghiae* ICBG1321, a symbiont of the stingless bee *Melipona scutellaris*

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In recent decades, it has been demonstrated that symbiotic microorganisms have the ability to biosynthesize secondary metabolites with high biological potential. Social insects are exposed to various abiotic and biotic environmental pressures. To deal with these environmental factors insects have evolutionary established different associations with microorganisms that act like their bodyguards, playing a vital function in chemical ecology. The knowledge of the protective ecological function of the natural products produced by symbiotic microorganisms may contribute to the discovery of compounds with different pharmacological activities, aligning ecological function to therapeutic applications. In this context, as part of an ongoing ICBG project between Brazil and USA, we have focused on the bioactive compounds produced by the microbial symbiont strain ICBG1321 associated with the stingless bee *Melipona scutellaris*. The actinobacteria ICBG1321 was isolated from nurse bees of *Melipona scutellaris* and identified as *Micromonospora tulbaghiae*, using 16S rRNA sequencing. This strain was screened against the entomopathogens *Metarhizium anisopliae*, *Beauveria bassiana* and *Paenibacillus larvae*, exhibiting pronounced inhibitory activity against *P. larvae*, the causative agent of American Foulbrood. *M. tulbaghiae* ICBG1321 was cultured in ISP-2 liquid medium using HP-20 as extracting resin. Then, the acetone extract from resin was partitioned between water and ethyl acetate. Next, the EtOAc extract was subjected to bioguided fractionation by SPE and HPLC, leading to the isolation of some compounds. NMR and MS data allowed the identification of four quinocyclines. These natural products show an unusual pyrrolopirrole moiety coupling via C-7/O-9 by a spiro bond to the antracyclinone, and are known as potent antibiotics. The ecological role for this class of metabolites is being investigated.

Oral Presentations III
Wednesday, October 24 (16:15-17:15 h)
Chair: Diogo Vidal

O-09 The sensory physiology of host-associated stimuli evaluation in head lice

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Head louse (*Pediculus humanus capitis*) is a cosmopolitan hematophagous insect that parasites humans. The high dependence on its host affects its behavior and physiology during food and refuge assessment. Our goal was to study whether head lice rely on chemical and physical information while they evaluate a potential host. First, we explored the morphology of the main sensory organs of lice in order to describe the diversity of sensory structures. We identified 3 types of chemoreceptors: 2 olfactory sensilla and 1 contact chemoreceptor located at 3rd flagellomere. In addition, we identified 2 tuft organs (2nd and 3rd flagellomere) and 1 pore organ (3rd flagellomere), similar to those described in body lice. Second, we analyzed the behavioral response of lice to host associated stimuli: chemical (human scalp), thermal (heated substrate) and hygric (humid substrate) stimuli in two choice assays. We found that human scalp stimuli were highly attractive for head lice, being insects arrested around the stimulus. Similarly, when both zones of the arena were settled at different temperatures, lice preferred resting at 32 °C instead of 22°C. Finally, when humid versus dry substrates were offered, insects exhibited aversion for the wet substrate. Under the ablation of the antennal segments, we found that the detection of chemical, thermal and hygric stimuli was concentrated in the 3rd flagellomere. Third, in order to describe the central structures involved in peripheral processing, we traced the antennal neurons of the head louse to the brain. By means of anterograde backfills, we found antennal projections arborising in a neuropil, that we identified as the antennal lobe.
This study integrates morphological and behavioral aspects of the sensory machinery of head lice involved in host perception.

O-10 This work is not presented

Oral Presentations IV

Thursday, October 25 (9:45-10:45 h)

Chair: Marcia González-Teuber

O-11 Insect-corn kernel interaction: Chemical signaling of the grain and host recognition by *Sitophilus zeamais* (Coleoptera: Curculionidae)

Virginia L. Usseglio[1,2*], Yesica P. Zaio[1,2], José Sebastián Dambolena[1,2,3], Carolina Merlo[1,4], María L. Peschiutta[1,2], María P. Zunino[1,2,3]

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In living organisms, the cuticle has structural functions and is involved through chemical signaling in biological interactions such as plant-insect and provides protection against biotic and abiotic factors, thereby avoiding desiccation or predators' attack. The objective of this study was to investigate the participation of the epicuticle in the interaction of the maize kernel and the maize weevil *Sitophilus zeamais*. For this study the extraction of epicuticle was carried on and the extract was analyzed by GC-MS. Digital photographs of cross sections of grains with and without epicuticle were taken, and behavior bioassays were carried out with both grains with and without epicuticle and epicuticle extracts. The GC-MS analysis of the epicuticle extract demonstrated the presence of aliphatic hydrocarbons, alcohols, ethers, fatty acids, sterols and their derivatives. The results of preference bioassays showed that the epicuticle of maize has a primordial role in its interaction with *S. zeamais* participating in the recognition and attraction to the food source. According to these results, in the assay of kernels' susceptibility to insect attack, kernels without epicuticle were significatively less damage than kernels with epicuticle. In progeny assays, the exposition of *S. zeamais* adults to kernels without epicuticle caused a reduction in progeny, indicating that it could regulate the reproduction of *S. zeamais*. In addition, the compounds present in the epicuticle extract may act as signalling molecules and developmental regulators. This study reveals the effect of the maize kernel epicuticle on *Sitophilus* behavior and contributes to the understanding of their interaction.

O-12 Kin Recognition in a Subsocial Treehopper (Hemiptera: Membracidae)

Daniel Torrico-Bazoberry[1*], Liliana Cáceres-Sánchez[1], Luis Flores-Prado[1], Daniel Aguilera-Olivares[1], Francisco E. Fontúrbel[1], Hermann M. Niemeyer[1], Carlos F. Pinto[1]

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Insects exhibiting parental care usually can discriminate between kin and non-kin individuals, allowing parents to avoid investment in foreign offspring. This study investigated the occurrence of kin recognition in the sap-feeding insect *Alchisme grossa* Fairmaire (Membracidae) through bioassays assessing median female distance to nymphs and degree of nymphal aggregation. Each bioassay involved groups consisting of a female and a cohort of kin or non-kin nymphs (mother and non-mother treatments, respectively). Furthermore, cuticular non-volatile compounds were extracted from nymphal cohorts, analysed by gas chromatography-mass spectrometry (GC-MS) and compared between cohorts. In both treatments, nymphs performed a 'rocking behaviour' which appears to be correlated with aggregation. Temporal patterns of degree of nymphal aggregation and median female–nymph distance differed between treatments, the former parameter being higher in the mother treatment and the latter being higher in the non-mother treatment. A total of 40 compounds were found in the extracts. The composition of cuticular non-volatile compounds differed between nymphal cohorts. These results support the notion that kin recognition in *A. grossa* is possibly mediated by nymphal rocking behaviour and/or cuticular non-volatile compounds (i.e. visual and/or chemical cues).

O-13 Male-specific volatiles of the citrus borer, *Diploschema rotundicolle* (Coleoptera: Cerambycidae): Identification and field evaluation

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The citrus borer, *Diploschema rotundicolle* (Coleoptera: Cerambycidae), is a native longhorn beetle species that has become a serious citrus pest in Uruguay, due to dramatic population increases, particularly in southern-Uruguay lemon groves. High infestation levels cause an overall deterioration of the tree structure, resulting in important yield reduction and even tree death. Currently, the only available management strategy is cultural control by trimming infested branches, which is expensive in labor costs and mostly inefficient. The aim of this work was to study the chemical communication system in *D. rotundicolle*, in order to develop a tool for monitoring and potential control strategy of this insect. Field-collected male and female adults were studied for their volatile chemistry by air entrainment, GC-MS and chiral GC analysis. We found that males produce large amounts (up to 0.4 mg/insect/day) of (3*R*)-3-hydroxy-2-hexanone (herein 3*R*-HK). Males also produce some minor compounds (less 2% of chromatogram area), including primarily 2,3-hexanediol (at least two stereoisomers) and 2,3-hexanedione. GC-EAD analyses showed that both female and male antennae respond to the racemic mixture and to synthetic 3*R*-HK, as well as to male-produced 3*R*-HK, suggesting that the male-specific volatiles function as an aggregation-sex pheromone, as has been reported for several Cerambycine species. No antennal response was observed for 3*S*-HK, suggesting that the non-natural stereoisomer is not detected by the insects, which implies that the racemic mixture may be suitable for application purposes. Racemic HK and 3*R*-HK were synthetized and tested in cross-vane traps in a citrus grove in southern Uruguay, during the summer of 2017/18. No significant captures of *D. rotundicolle* adults were observed, suggesting that minor compounds may be needed for attraction. Incidental and significant captures of an untargeted Cerambycine species, *Retachydes thoracicus*, are also reported.

O-14 Green and cost-effective synthesis of *N*-(2'*S*)-methylbutyl-2-metylbutylamide, the sex pheromone of the longhorn beetle *Migdolus fryanus* (Coleoptera: Cerambycidae)

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The coleoptera *Mygdolus fryanus* poses a serious threat to several agricultural crops in Brazil, especially causing extensive damage to sugarcane plantations. Ten species of the *Migdolus* genus (Coleoptera: Cerambycidae) are found around the country and, among them, *M. fryanus* is the most prevalent. This beetle is an important pest for sugarcane culture at the beginning of its life cycle, when the larvae penetrate the soil and feed from the plant roots. Adult insects also spend most of their time underground, especially the females, emerging only during mating season. Large-scale pesticide use, aiming to reduce losses by the attack of crop pests, has increased over the years; however, the insect underground life habit makes its chemical control a challenge. In this context, using the pheromone as an alternative to control the insect population gained relevance, boosting a rising interest in the synthesis of this class of compound. Our group has developed a method to synthesize *M. fryanus* sex pheromone from commercially available starting materials. Notwithstanding, the cost of one of the reagents, 2-methyl-1-butylamine (even the racemic mixture), considerably increases the final product price and hinders its use as a pest control tool. The present work aims, therefore, to propose a highly efficient synthetic pathway to produce the pheromone, N-(2'*S*)-Methylbutyl-2-metylbutylamide, using low cost natural products to obtain the precursor amine. The amine synthesis is carried out through a decarboxylation of isoleucine catalysed by (*R*)-carvone, which gives the amine with the desired configuration with 82.9% yield. The pheromone is then prepared by reacting equimolar quantities of (2*S*)-methyl-1-butylamine and 2-methylbutanoic acid. Water formed during the reaction is retained in molecular sieves. An intermediate bearing a quaternary nitrogen atom is generated. Then, it is condensed, leading to the formation of the amide and the release of water. The second step of the synthesis, which is quantitative, produces N-(2'*S*)-Methylbutyl-2-metylbutylamide with an overall yield of 82.9%.

Oral Presentations V
Thursday, October 25 (14:15-15:30 h)
Chair: Jaime Martínez-Harms

O-15 Are four better than two? Testing the attractiveness of a quaternary blend in males of *Diatraea saccharalis* in flight tunnel experiments

Maycon Silva[1*], Angela Palacio-Cortés[1], Gleen Svensson[2], Christer Löfstedt[2], Paulo Zarbin[1]

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The sugarcane borer *D. saccharalis* is the major pest insect attacking sugarcane crops in Brazil.Two sex pheromone components (*Z*,*E*)-hexadec-9,11-adienal and (*Z*)-hexadec-11-enal have been reported to elicit antennal activity in GC-EAD analysis and to elicit positive response in wind tunnel assays in *D. saccharalis*. However, attractiveness of these two compounds has not been confirmed by field tests. We identified based on GC-EAD and GC-MS analysis two additional compounds that elicited antennal activity in male *D. sacharralis*, (*Z*)-hexadec-9-enal and Hexadecanal. The goal of this study was to test if this two new identified compound increase the attractiveness of *D. saccharalis* males in wind tunnel assays. Flight tunnel assay were performed in a 0.9×0.9×3 m Plexiglas flight tunnel at Lund University, Lund Sweden. Six behaviors were recorded: (1) no reaction; (2) activation, (3) taking off, (4) oriented flight, (5) flying at least 10 cm from source of odor and (6) landing or source contact. In this experiment, 30 males were used, and males were used only once.**Experiment: Treatment 1:** Female extract 1 female equivalent (1FE); **Treatment 2:** binary blend **(**Z9,E11-16:Ald and Z11-16:Ald, 100pg per dose in the ratio 10:1); **Treatment 3:** quaternary blend (Z9,E11-16:Ald, Z11-16:Ald, Z9-16:Ald and 16:Ald, 100pg per dose in the ratio 10:1:1:1). Flight tunnel results showed similar positive responses between the Treatment 1 and 3 (24 and 23), while Treatment 2 had the lowest score (14) of positive responses. Here, we showed that this two new identified compound increase the attractiveness of males in *D. saccharalis* in wind tunnel assays. We hope that the identification of this two new activities compounds Z9-16:Ald and 16:Ald can be a stepforward for the elucidation of the chemical communication in *D. saccharalis* and also improve the integrated pest management (IPM) programme on this major pest on sugarcane crops.

O-16 Does Si fertilization alter the attractiveness of herbivore-induced plant volatiles to the minute pirate bug *Orius insidiosus*?

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Fertilization with Silicon (Si) has been employed in agriculture with the aim to enhance plant agronomic traits and resistance to abiotic and biotic factors. Si accumulation in plant tissue, besides forming a mechanical barrier against herbivory, activates jasmonic-acid signaling pathway, and hence increases plant resistance through augmented levels of chemical defenses. As a result of activating JA pathway, Si-fertilized plants must release a different blend of herbivore-induced plant volatiles, which are important chemical cues for herbivore natural enemies in host location. In this context, the aim of this work was to assess the potential of Si as an elicitor of indirect plant defenses in corn against its key-pest *Spodoptera frugiperda* (Lepidoptera: Noctuidae). Olfactory response of the minute pirate bug *Orius insidiosus* (Hemiptera: Anthocoridae), a generalist predator that prey on neonate fall armyworm, was assessed in a Y-tube olfactometer using corn seedlings as sources of volatiles. Plants were fertilized with Si (Si+) applied using "*drench"* method at 1% (2 ton SiO_2 ha^{-1}). The predator did not orient to constitutive plant volatiles and Si fertilization did not induce attractive volatiles from uninfested corn plants. Expectedly, *O. insidiosus* was attracted to volatiles emitted by neonate *S. frugiperda*-infested plants over uninifestedplants, irrespective of Si treatment. However, when *O. insidiosus* was given a choice between volatiles of Si- and Si+ plants, both infested by neonates, the predator preferred Si+ plants. Therefore, Si fertilization in corn shows a great potential to be incorporated as a tactic of integrated pest management as it not only works as an elicitor of plant direct defenses, but also indirect ones by enhancing attractiveness of herbivore-induced plant volatiles.

O-17 Integrating plant natural resources use and urban pests' control. The case of *Haplopappus platylepis* (Asteraceae) resin as a substrate for sticky trap

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Chilean Matorral is a biodiversity hotspot. This biome, besides of corresponding to a site of high richness and endemism of plant species, possesses a myriad of natural resources that have not been explored. Among these is the resinous exudate of Chile's endemic bush *Haplopappus platylepis* (Asteraceae). This plant naturally capable of trapping insects thanks to the copious secretion of this resin over its inflorescences. In this work we evaluate the property of this secretion as a sticky trap for crawling pest insects using a commercial trap as a control and analysed these two sticky substances using UHPLC-DAD-MS and GC-MS. Resin was equally effective as commercial sticky trap substrate catching crawling insects, for test we use the cosmopolitan and synanthropic cockroach *Blatta orientalis* (Blattidae). Also *H. platylepis* resin's was composed by a mixture of flavonoids, labdane diterpenoids and unsatured fatty acids oxylipins, which are known for their antimicrobial and antioxidant properties. Therefore, beside of trapping pest insect this mixture may also destroy potential associated pathogenic microorganisms. On other hand, commercial trap has compounds that have been described as potentially toxic for humans as 1-bromohexadecane and 2-clorociclohexanol. Considering these findings, we suggest the resin of *H. platylepis* as suitable sticky trap material. We discuss on the value of exploring Chilean Matorral chemodiversity in search of resources that offer an alternative eco-friendly for pest control in urban environments.

O-18 Response of *Apis mellifera* towards chemical compounds associated with *Varroa destructor* infested-brood

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Varroa destructor constitutes one of the main problems facing the beekeeping. This parasite spends its life in the honey bee nest either on immature stages or on adult bees. *Apis mellifera* displays a social health mechanism against brood diseases that consists in detect, uncap and remove dead or diseased brood from the hive, the hygienic behavior. The detection and removing of brood infested by worker bees, interrupt the reproductive cycle of the mite and hence limit its population increase in the hive. This behavior would be induced by olfactory cues. In previous studies, we found two novel candidate compounds associated with infested brood that could trigger hygienic behavior: alpha pinene and hexanoic acid ethyl ester. The aim of this research was to evaluate the removal behavior of workers bees towards these two chemical compounds associated to the mite infestation in healthy brood cells. Treated cells were prepared by inserting small filter papers with 2 ul of a compound in two different times of bee brood development: larvae and pupae. Four treatments were applied in 25 healthy larvae: alpha pinene, hexanoic acid ethylester, a mixture of equal parts (Mix) and deionized water (control). After 48 h the number of brood removed cells was recorded. Worker bees removed higher percentages of brood withhexanoic acid ethyl esterand mix than with alpha pinene and control. Also, this tendency was greater when the treated brood were pupae. These results suggest that the stageof brood development and particular odors influence the hygienic behavior.Our results showed new compounds associated to brood infested by *V. destructor* that triggersthe removal behavior. This information contributes to a better understanding of this social mechanism against the mite and provides tools to the selection of bee strains exhibiting higher tolerance to the parasite.

O-19 Macrolides as possible kairomones from the Mediterranean flour moth *Anagasta kuehniella* Zeller (Lepidoptera: Pyralidae)

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A*nagasta kuehniella* is popularly known as Mediterranean flour moth. The eggs from this moth are among the most nutritious for mass-rearing of natural biological control agents, specially from the parasitoid genus *Trichogramma* (Hymenoptera). One of the main problems on *A. kuhniella* mass-rearing is caused by the ectoparasitoid *Habrobracon hebetor* (Hymenoptera), which feeds on lepidoptera's larvae. Experimental data showed that *H. hebetor* are strongly attracted to *A. kuhniella* frass, suggesting the presence of a volatile kairomone. A possible solution for *H. hebetor* infestations would be the use of traps using the synthetic kairomone as lure. Based on previous observations, this study aims to extract, identify and synthesize the compound(s), which are bioactive in *H. hebetor* from *A. kuehniella* frass. Natural samples were prepared by extracting fresh *A. kuehniella* frass with dichloromethane, followed by fractionation on silica flash. Bioassays showed that one fraction, which contained two compounds was attractive to *H. hebetor* females. GC-MS and GC-FTIR analyses suggested the structures of two macrolides, (*9Z*)-octadecenolide and *(9Z,12Z)*-octadec-dienolide. GC-MS analysis of a derivatization performed with DMDS suggested the position of double bonds. A synthetic route with 7 steps was proposed for (*Z*)-octadec-9- enolide, starting with 1,9-nonanediol. In the last step, the ring closing metathesis carried out the macrolide (*Z*)-octadec-9-enolide. MS and FTIR spectra, and retention indexes found for the syntheticmatched the data for the natural, confirming the proposed structure as (*Z*)-octadec-9-enolide. The structure of *(9Z,12Z)*-octadec-dienolide will be confirmed by synthesis, which is already being developed. The synthetic route proposed has 11 steps and starts with 1,3-propanediol, 1,6-hexanediol e 1,9-nonanediol. The macrolactonization reaction of hydroxy acid will be performed with the Corey-Nicolaou method. After synthesis, laboratory and field bioassays using the synthetic compound are underway in order to test the attractiveness of individuals of *H. hebertor*.

Oral Presentations VI
Friday, October 26 (9:45-10:45 h)
Chair: José Mauricio S. Bento

O-20 Impact of benzoxazinoid sequestration by the Western Corn Rootworm on the biocontrol potential of entomopathogenic nematode isolates from Mexico

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The Western Corn Rootworm (WCR) *Diabrotica virgifera virgifera* LeConte (Coleoptera: Chrysomelidae), is a root-feeding specialist on maize (*Zea mays* L.). Entomopathogenic nematodes (EPNs) are used as biological control agents against this important pest. Robert et al. (2017, eLife, https://doi.org/10.7554/eLife.29307.001) showed that WCR sequesters benzoxazinoid (BX) chemical defenses and that this increases WCR resistance against a commercial strain of EPN, thereby possibly limiting their efficacy as biological control agents. However, to date, little is known about the impact of BX sequestration on different EPNs, including naturally occurring strains. In the context of a collaborative project, we want to test the biological control potential of EPNs from Mexico, from where WCR originated approx. 1000 years ago, and how they may be affected by WCR BX sequestration. In a first step, we surveyed and screened EPNs from Mexican maize fields and evaluated their virulence against WCR larvae and against the non-BX sequestering *D. balteata*. Of the five EPN species that we found, *Heterorhabditis bacteriophora* was by far the most common and different isolates showed substantial variability in causing mortality in WCR larvae, in contrast to the overall very high mortality caused in *D. balteata* larvae. Currently, we use mutant maize plants impaired in benzoxazinoid production (Maag et al., 2016, The Plant Journal, https://doi.org/10.1111/tpj.13308) to evaluate to what extent BX sequestration by WCR is affecting the ability of the different EPN isolates to kill WCR larvae. These results will increase our understanding of the impact of WCR self-defense on the efficacy of EPNs as biological control agents against WCR.

O-21 Estimation of the scattering of *Diatraea crambidoides* Grote (Lepidoptera: Crambidae) using traps with sexual pheromone in sugar cane crop

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The sugarcane borer,*Diatraea crambidoides* Grote is one of the most important pests in the Guatemalan sugar industry. The sterile insect technique (SIT) consists of a birth control, which takes advantage of the natural instinct of insects' mating. When a sterile male is released and copulates with a wild female the resulting postures are unviable. For the use of SIT, it is necessary to previously know insect dispersion, which allows determining the number of release points. Thus, scattering studies help to understand the behavior of the insect and its ecological interactions. Therefore, the object of this study was to quantify the daily distance of movement and the dispersion of the stem borer *D. crambidoides* at adult stage. It was carried out using the marked release and recapture method, using pheromone from virgin females as attractants. The marking of the males was done by the fluorescent powder Fire Orange ™ Pigment A-14-N in the chrysalis stage. It was determined the stem borer male dispersed 53.8 meters per day with a heterogeneous distribution according to the model of Dobzhansky and Wright. 8% of the insects were recaptured. Recaptures ranged between 12 and 0 adults per trap and 51% of recaptures were obtained between 50 and 100 meters from the release point, which were statistically equal. The spatial distribution of captured insects was represented through Kriging. The model that best fits the empirical semivariogram was circular with a spatial dependence index of 64.09% which is considered moderate.

O-22 Improved monitoring of oriental fruit moth (Lepidoptera: Tortricidae) with terpinyl acetate plus acetic acid membrane lures

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Male and female moth catches of *Grapholita molesta* (Busck) in traps were evaluated in stone and pome fruit orchards untreated or treated with sex pheromones for mating disruption in Uruguay, Argentina, Chile and USA from 2015 to 2017. Trials evaluated various blends loaded into either membrane cup lures or septa. Membrane lures were loaded with terpinyl acetate (TA), acetic acid (AA) and (*Z*)-3- hexenyl acetate (Z3) alone or in combinations. Two septa lures were loaded with either the three-component sex pheromone blend for *G. molesta* (OFM-PH) alone or in combination with codlemone (2-PH), the sex pheromone of *Cydia pomonella* (L). A third septum lure included the combination sex pheromone blend plus pear ester, (*E,Z*) 2,4- ethyl decadienoate (2-PH/ PE), and a fourth septum was loaded with only β-ocimene (BO).
Results were consistent across geographical areas showing that the addition of BO or Z3 did not increase moth catches. The addition of pear ester to the sex pheromone lure (2-PH/ PE) marginally increased moth catches. The use of TA and AA together significantly increased moth catches compared with the use of only one of the two components. The emission rate of AA was not a significant factor affecting the performance of the TA/AA lure. The addition of TA/AA significantly increased moth catches when combined with the 2-PH lure. The TA/AA lure also allowed traps to catch both sexes. Optimization of these complex lures can likely further improve manager´s ability to monitor *G. molesta* and help to develop multispecies tortricid lures for use in individual traps.

O-23 Big avocado seed weevil *Heilipus lauri* management with volatile organic compounds produced by males of this species

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The big avocado seed weevil, *Heilipus lauri*Boheman (Coleoptera: Curculionidae), is one of the most significant pests of avocado in Colombia and other countries, such as Mexico. The volatile compounds produced by males and females were collected by headspace-solid phase microextraction (HS-SPME) and dynamic headspace collection (DHS) on a sorbent. Comparative analysis of these volatile compoundswas performed using gas chromatography (GC-FID) and gas chromatography coupled with mass spectroscopy (GC-MS). Four male-specific compounds were identified as grandisol, papayanol, papayanal and grandisal in a ratio of 94.8:3.0:1.8:0.4. These results may help in integrated pest management by using these semiochemicals for trapping and controlling population of this species.

Acknowledgements

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Abstracts of Posters

Poster Session I
Wednesday, October 24 (17:30-19:00 h)

P-01 Volatile and non-volatile putative host kairomones mediating *Diaphorina citri* oviposition

Anna Paula Burgueño[1*], María Eugenia Amorós[1], María Laura Umpiérrez[1], Federico Rodrigo[1], José Buenahora[2], Andrés López[3], Guillermo Moyna[3], Carmen Rossini[1]

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Huanglongbing, currently the most destructive citrus disease worldwide, is dispersed by the Asian citrus psyllid (ACP), *Diaphorina citri* (Hemiptera: Liviidae). During host plant search, ACP can integrate information from flushing shoots including visual, odor and contact cues.
A preference greenhouse experiment carried out using 6 citrus species: Citron (Citrus medica), Eureka lemon (Citrus limon), Cravo lemon (Citrus limonia), Rough lemon (Citrus jambhiri), Sweet orange (Citrus sinensis) and Duncan grapefruit (Citrus paradisi) has shown an oviposition preference of ACP for Duncan grapefruit, Sweet orange and Rough lemon.
Elemental analyses on shoots from the 6 species showed no significant diferences correlated to the oviposition preference.
Therefore we have searched for biomarkers that may point to putatitve kairomones in the volatile organic compounds (VOCs) and in the $CDCl_3$ and D_2O extracts from shoots of the six citrus hosts (N = 6/species).
GCMS data from VOCs were conventionally analyzed and a matrix with 81compounds was obtained. The $CDCl_3$ and D_2O extracts wer analyzed by NMR and the data were processed with MestReNova 12.0 generating matrices of 30x1792 and 30x1521 for $CDCl_3$ and D_2O extracts respectively.
The three matrices were then subjected to multivariate analyses (PCA and PLS) using the MetaboAnalyst 4.0 web platform.
Chemical profiles of the VOCs or the $CDCl_3$ extracts show no distinction between species. In the case of D_2O extracts, the chemical profiles of Sweet orange and Duncan grapefruit were similar and grouped; being different from the profiles of Citron while the Eureka, Cravo and Rough lemons exhibited intermediate chemical profiles .
These results correlate to the preference of oviposition and may point to non-volatile polar compounds as responsible for the differences between groups as possible cues that ACP can use to choose oviposition plants.
Further investigation to determine the identity of these compounds will be persued.

P-02 Does the herbivory of *Diabrotica speciosa* affect the reproduction of pepper plants cultivated in the field?

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Herbivorous insects consume both the vegetative and reproductive tissues of plants, affecting their growth, reproduction and survival. Due to the strong selection pressure exerted by herbivores, plants have developed several defence mechanisms to reduce or prevent the attack of these organisms along the evolutionary process. One of the adaptations developed by plants consists of a trade-off in the investment of resources for synthesis of defences against herbivory, showing detrimental effects on growth and reproduction. In this study, we investigated how leaf herbivory and florivory of *Diabrotica speciosa* (Germar, 1824) (Coleoptera: Chrysomelidae) affect the reproduction of bell pepper plants cultivated in the field, considering the production of flowers and fruits. Pepper plants were cultivated in an experimental field area. At the beginning of the vegetative stage, plants were infested with adult individuals (2 beetles/plant), which remained until the beginning of the flowering period. The plants were covered to prevent escape of the insects and to avoid the entry of other organisms. Control plants without beetles and not subjected to any mechanical damage were used. The amount of flowers and fruits of non-infested (control) and *D. speciosa* infested plants, along with the number of seeds produced per fruit were evaluated. Plants under the effect of herbivory produced a smaller amount of flowers than the control (P = 0.0015). Fruit yield was also lower in plants with the presence of herbivores than in the control (P = 0.015). In addition, the number of seeds was lower in the fruits of the plants that were affected by herbivory (P = 0.00015). These results suggest that the pepper plants submitted to herbivory of *D. speciosa* allocate energy for the synthesis of new defence compounds against herbivory to the detriment of reproduction.

P-03 Biosynthesis of terpenes in red clover (*Trifolium pratense*) and their role in the interaction with the root borer (*Hylastinus obscurus*)

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Red Clover (*Trifolium pratense* L.) is a legume with important economic value in seed industry and animal production. This short-lived perennial species is one of the most important legume crops in Chile used primarily in short-rotation pastures, grazing and cutting. However, *T. pratense* yields decline quickly after two years, because several factors including root rot and the infestation by the root borer *Hylastinus obscurus* (Marsham) (Coleoptera: Curculionidae). This curculionid is the most important insect pest attacking this foraging crop. Both larvae and adults feed into the roots when they construct galleries causing a significant reduction in levels of production and persistence of red clover. Currently, the role of semiochemical in the interaction between *H. obscurus* and red clover plants has been widely studied for our group. Previously, (*S*)-limonene identified from the areal part has shown a repellent activity against this Curculionid in olfactometric assay. We propose to evaluate volatile terpenes and the enzymatic production in Superqueli-INIA cultivar and test the extracts of the aerial part of the plant and pure compounds against *H. obscurus* by olfactometric tests. Volatile organic compounds emitted by red clover plant were captured in Porapak-Q column for 24 hours, then the compounds were desorbed with diethyl ether and hexane, finally volatiles mixtures were analyzed in a GC-MS equipped with a capillary column HP-1. The enzymatic production was evaluated using geranyl pyrophosphate (GPP) as substrate and Mn^{+2} as cofactor and terpene production was recorded by HS-GC equipped with a capillary column BPX-5. The olfactometric assay were performed in a four-arm olfactometer. Preliminary results showed that the aerial part of the plant released mainly (*S*)-limonene, β-pinene and 4-carene, and from the enzymatic activity it was possible to identify by Kovats Index and the injection of standard, compounds such as β -pinene, myrcene, (*S*)-limonene, geraniol, (-)-isoterpinone and perillyl alcohol.

Acknowledgment and founding: FONDECYT 1181697 and Laboratorio de Química Ecológica.

P-04 Preferences of quince (*Cydonia Oblonga* mill.) varieties by adults and larvae of codling moth (*Cydia pomonella* l.)

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Cydia Pomonella (L.), known as "codling moth", is a worldwide oligophagous pest of apples, pears, quinces and walnuts. The host finding is mediated by volatile compounds released by plants. The mated female performs recognition and preferences for oviposition guided by olfactory cues while the neonate larvae must find and enter quickly into the fruit; otherwise they would be exposed to unfavourable external conditions. The aim of this study was to determine the preferences of adult females and larvae of codling moth on four varieties of quince (*Cydonia oblonga* Mill.); Portugal, Smyrna, INTA 147 and Champion. Oviposition trials were conducted for preference of mated females through dual choice assays with two fruits of different varieties placed on acetate cards. After 12 days, the number of eggs and, oviposition marks per card were recorded. Larval preference was assessed through dual-choice bioassay in a Petri-dish. A neonate larvae was placed to choose between each of the four varieties arranged by pairs. The first choice, the time elapsed until fruit contact and, distances traveled by the neonate larvae were recorded. Codling moth's preference for oviposition was higher in Champion variety. Champion and Smyrna were more attractive for oviposition, while in INTA 147, fewer postures were recorded. Preference by neonate larvae was observed towards Champion variety, followed by Smyrna variety. INTA 147 and Portugal were the least preferred by neonate larvae. The results are important in the context of codling moth interactions with quinces and for the cultivation of less susceptible varieties to the codling moth infestation.

P-05 Peramine variation triggered by *Listronotus bonariensis* (Coleoptera: Curculionidae) herbivory intensity in the symbiotic system *Lolium perenne* – *Neotyphodium lolii*

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Listronotus bonariensis is a grass pest that feeds on perennial ryegrass, one of the main grass species used as forage in Chile. Pesticides have been the traditional way for controlling this pest, but these substances have been ineffective. Perennial ryegrass presents a symbiotic association with *Neotyphodium lolii* an endophytic fungus that can produce peramine, a bioactive alkaloid with effect on insect pests. The objective of this work was to determine variations of peramine concentration in *L. perenne*-endophyte system in response to damage intensity produced by *L. bonariensis* adults. Plants of *L. perenne* were growth on laboratory conditions and exposed to herbivory by different number of weevil adults (0, 1, 2, 4 and 8) for two weeks. Plant damage level was registered in the following way: 0 (no damage), 1 (slight damage) 2 (low damage), 3 (medium damage), 4 (high damage) and 5 (great damage) on leaves tissues. Quantification of peramine from ryegrass plants was performance by HPLC. The results showed significant differences in the peramine content between damage level 2 and 5 ($P<0.05$). The higher concentration of peramine in plants with a high level of damage suggests an induced response of the plant against the attack of *L. bonariensis*.

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P-06 Herbivory by conspecifics affects behavior and development of *Nematus Oligospilus* females and their offspring

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In most herbivores, females oviposition choices are crucial for their offspring, because larvae lack mobility to select their own feeding places.
The willow sawfly, *Nematus oligospilus* (Förster), is an exotic pest in *Salix* commercial forests and has been reported worldwide. Females of this species must find and recognize their host plant when they emerge as adults after pupating in the soil. In the context of the preference-performance hypothesis, we evaluated the effect of conspecific herbivory on the oviposition behavior and the larval performance of *N. oligospilus* females, reared on damaged and undamaged plants; and we compared the chemical profile of volatiles of damaged and undamaged plants.
We conducted behavioral experiments to see how females make oviposition decision. *N. oligospilus* females preferred leaves of *Salix humboldtiana* without previous exposition to larvae of its own species for oviposition. Since females oriented towards undamaged leaves without contact, results suggested that a long distance cue could be acting as a first repulsive system alarm of the damaged plant. Then, we evaluated larvae development on damaged and undamaged leaves. We found that the first stages of development were affected since the percentage of hatching was lower, the larval size was smaller and the time to pupation was higher in larvae reared on damaged plants. We did not find significant differences in the pupal weight and fecundity from individuals reared either on damaged or undamaged leaves. Finally, in a search of the chemical cues associated to this host accepting behavior, plant volatiles were analyzed. We found significantly more sesquiterpenes in damaged plants, particularly germacrene D, which was released in higher amounts in the previously induced feeding plants. We proposed that these compounds could be acting as important cues to avoid unfavorable leaves for the larvae.

P-07 Effects of high copper concentration on florivory in *Oenothera picensis* ssp. *picensis* (Myrtales; Onagraceae)

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It has been widely recognized that metal contamination can affect plant-animal interactions; however, few studies have explored the effects of the accumulation of metal contaminants in plants on their interaction with floral visitors. *Oenothera picensis* ssp. *picensis* (Myrtales; Onagraceae) is a plant native of central Chile. Populations of this species growing around a copper (Cu) smelter accumulate high concentrations of Cu in their flowers. This study evaluates: 1) if concentrations of Cu in soil are correlated with concentrations in flowers and 2) if accumulation of Cu in plants may affect plant-animal interactions, specifically florivory, measured as percentage of open flower with visible florivore's damage. We selected three sites along a linear transect away from a smelter located at Ventanas in V Region, Chile, and determined: i) Cu concentration in soil and in floral tissues and ii) florivory. We found a correlation between Cu concentration in soil and in floral tissues. Moreover, flowers from plants growing on soils with the highest Cu concentration (481 ± 64 mg de Cu/kg) showed least florivory (22.6%), while plants from the site with intermediate and low Cu concentration (241 ± 79 and 43 ± 2 mg de Cu/kg) showed the highest percentage florivory (28.7% and 24.1%, respectively), although these differences were not significant (Kruskal-Wallis; H = 1.95, p= 0.37). These results suggest that Cu in floral tissues may provide defense against florivores when present at high concentrations, but render the plant more vulnerable to florivore attack when present al low concentrations. Possible origins of these effects will be discussed.

P-08 Repellence of the *Schinus terebinthifolius* Raddi (Anacardiaceae) essential oil against two pests of stored products

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Schinus terebinthifolius Raddi (Anacardiaceae) is a perennial tree native to Central and South America whose fruits are popularly known as pink pepper, Brazilian pepper, Florida holly or christmas-berry. The objective of this study was to evaluate the repellent activity of the essential oil (EO) extracted from *S. terebinthifolius* ripe fruits against adults of *Lasioderma serricorne* and *Alphitobius diaperinus*, two important coleopteran pests of stored products. Ripe fruits of *S. terebinthifolius* were collected in Maceió, Alagoas State, Brazil, and after maceration the EO was extracted in triplicate by hydrodistillation and then analyzed by GC-FID and GC-MS. The bioactivity of the EO was assayed using a four-arm olfactometer for adults of *L. serricorne* (n = 24), while the behavioral response of *A. diaperinus* adults was evaluated by bioassays in a Y-tube (n = 30). The EO was tested in two doses (1µL and 10µL). Data from four-arm olfactometer bioassays were collected using the Olfa software and then statistically analyzed (ANOVA, Skott-Knott test). The responses of *A. diaperinus* were submitted to chi-square test. The identification and quantification of the EO compounds was done by GC-FID and GC-MS analyzes. 14 compounds, equivalent to 96.13% of the oil, were identified, most of them monoterpenes. The major compounds of the oil were β-pinene (49.8%), α-pinene (33.49%), 3-carene (5.85%), germancene-D (2.08%) and bornylene (1.21%). The EO of *S. terebinthifolius* presented strong repellency against *L. serricorne* (10µL: $P < 0.01$) and against *A. diaperinus* (10µL: $P < 0.001$; 1µL: $P < 0.05$). Therefore, the EO of the fruits of *S. terebinthifolius* and its constituents are natural products with considerable potential for use in IMP strategies as natural repellents in the protection of stored products, including in organic production systems.

P-09 Electrophysiological responses of *Xanthogaleruca luteola* (Müller) (Coleoptera: Chrysomelidae) to volatile organic compounds from *Eucalyptus globulus*

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Xanthogaleruca luteola (Müller) is a monophagous pest species indigenous to Europe, known as "Elm leaf beetle". During the larval and adult stages, this insect damages elm leaves as it chews small holes in the leaves, causing, even, complete defoliation, leaving only the nervation. Although this species only use *Ulmus* spp as host-plants to complete its development, some preliminary results have shown that is attracted to non host-plants such as *Eucalyptus globulus*.
In order to understand the role of volatile organic compounds emitted by *Eucalyptus globulus* when the insect is attracted to this non host-plant, dichloromethanic extracts of *Eucalyptus globulus* were analyzed through gas chromatography-mass spectrometry, where the main compounds were identified. Furthermore, in order to evaluate the response of the antennae in *X. luteola* males and females to the compounds contained in the extract, a gas chromatographic-electroantennographic detection was conducted where only females were observed to respond to α.-pinene, eucalyptol, 4-terpineol, α-terpineol, α-terpineol acetate, α-gurjunene, alloaromadendrene, longifolene, (+)-ledene and globulol compounds. This study is the first step to identify substances mediating host-plant selection of *X. luteola*.

P-10 Does herbivory of the southern red mite lead to multiple infestation by passionvine mealybug in *Coffea arabica* plants?

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Attraction of arthropods to infested plants can be mediated by herbivore-induced plant volatiles, conferring advantages when the colonizing herbivore manipulates plant defences, and hence favours feeding and development of the second species. There is a great interest in investigating the effects of multiple herbivory in agricultural systems as infestation by more than one attacker is a common scenario. Coffee is a prominent crop in Brazil, which is the world's largest producer and exporter, but its yield is limited by attack of several arthropod pests. In this context, the aim of this work was to evaluate whether infestation by southern red mite (*Oligonychus ilicis*) (McGregor) (Acari: Tetranychidae) in coffee (*Coffea arabica* L. cv. Mundo Novo) leads to infestation and settlement of the passionvine mealybug (*Planococcus minor*) (Maskell) (Hemiptera: Pseudococcidae), that is, the multiple infestation. Host choice of 3rd instar nymphs of the mealybug (20 insects) was evaluated in an arena containing a mite-infested plant and an uninfested, at intervals 24, 48 and 72 h after release of the nymphs. Mealybug settlement was assessed in terms of colony growth in uninfested and mite-infested plants using a founder population of 50 1st instar nymphs each plant. In the free choice test, *P. minor* preferred mite infested plants over uninfested plants. In addition, the development of *P. minor* was superior in mite-infested than in the uninfested plants. Therefore, colonization of coffee plants by *O. ilicis* makes the plant more susceptible to subsequent infestation by *P. minor*, indicating that occurrence of multiple infestation in coffee by these two pests is a likely scenario in the field.

P-11 Development of a cheap, efficient synthetic host odor blend to attract and capture triatomines, vectors of chagas disease

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Chagas disease remains as an important vector-borne neglected disease. In the absence of an effective treatment for chronic human infection or vaccines, the prevention of vector-borne transmission of Chagas disease relies on suppressing house infestations by triatomine bugs. Vector control is mainly accomplished by insecticide spraying. However, this is not ideal considering that insects can develop resistance to insecticides, and that these chemicals could affect people. The use of lured trap devices appears to be a sustainable and an environmentally-friendly method for vector monitoring and control. Our aim is to develop attractive odor lures to be used in field traps. It has already been shown that a synthetic, CO_2-free, host odor blend can efficiently attract and capture triatomines. This blend consists of L(+)-lactic acid, pentanoic acid and ammonia (the basic blend). The aim of this study was 1) to develop an efficient blend as cheap as possible and2) to increase the attraction efficiency of the blend. Tests were carried out using *T. infestans* nymphs in a dual-choice trap olfactometer. Odors were delivered from LDPS (Low density polyethylene sheets) bags. To assess this 1) we replaced lactic acid (2-Hydroxypropanoic acid) with the cheaper pyruvic acid (2-Oxopropanoic acid, a host odor detected by triatomines) and 2) we added a 4th component to the basic blend: 3-methyl 1-butanol (another host odor). Results showed low attraction and capture efficiency of the blend with pyruvic acid, even when this compound was tested at 3 different doses. The negative control showed 9% capture, the positive control (mouse) showed 72%, while blends with pyruvic acid reached 30% capture at most. Thus, in the context of our tests, blends with pyruvic acid are not efficient at attracting and capturing triatomines. Similarly, in the other series of experiments, mixtures with 3-methyl 1-butanol were not efficient at attracting and capturing triatomines. Results of these tests will be discussed.

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P-12 The role of cuticular lipids in the behaviour of Triatomines

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Insect cuticular lipids (CL) are usually involved in intraspecific chemical communication as contact pheromones for mate recognition or aggregation behaviour. The aim of the present work was to study the role of CL in sexual and aggregating behaviour.
Firstly, we studied the role of CL in mating behaviour of the kissing bug *Rhodnius prolixus*. We recorded the frequency of copula of a male versus a female with different CL compositions (treatments). Results suggested that during copulation attempts, both males and females of *R. prolixus* are able to recognize themselves by detecting a differential relationship of a non-hydrocarbon lipid compound, cholesterol, present in their cuticle.
Secondly, we focused on the aggregation behavior of another bug, *Triatoma infestans* This behaviour is mediated by thigmotaxis, a volatile signal presents in its faeces and/or by non-polar substances of low volatility that these insects leave footprints. Behavioural assays showed that *T. infestans* would leave traces of compounds that would come from glandular structures located in their tarsus. As a result, an aggregation behaviour of these insects is observed on these treated surfaces. Results of chemical analyses showed that linear and branched alkanes of long chain and aldehydes are predominant in greater proportion on the tarsus than on the legs. These compounds or some of them might be components of tarsal glands of *T. infestans*.
Taking into account that *T. infestans* and *R. prolixus* are vector of Chagas disease in South and Central America, the knowledge of the mechanisms underlying chemical intra-specific communication might help in the development of new tools useful to control vectorial transmission.

P-13 Identification of a male specific compound of *Amerrhinus ynca* Sahlberg (Coleoptera: Curculionidae)

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The leaf rachis borer, *Amerrhinus ynca* Sahlberg (Coleoptera: Curculionidae) is a Brazilian endemic pest which attacks palm trees, and the coconut culture (Cocos nucifera L.) is one of its host species. Due to the periodicity and intensity of its attack, *A. ynca* has been highlighted in the Bahia State, where the largest coconut plantation in this country is found, causing a reduction of productivity and large economic losses. So far, there are no registered insecticides or efficient techniques for control of this weevil. Thus, this work aims to extract, identify and synthesize the pheromone produced by *A. ynca*, in order to provide a method for monitoring and/or control this pest. For this, the insects were collected, separated by sex, reared in plastic cages under ambient conditions of temperature, humidity and photoperiod. The volatile compounds released by males and females were collected by the aeration process and extracted with hexane. The extracts were then analyzed by GC-FID, and the comparison of the chromatograms showed a male specific compound. CG-MS and CG-FTIR analysis allowed to propose the chemical structure as octadecanal, which was confirmed by coinjection with synthetic standard. Olfactometer bioassays and GC-EAG analyzes are underway to verify the bioactivity of both the natural male-specific extract and the synthetic octadecanal. After confirmation of the bioactivity of the synthetic compound, field tests will be performed.

P-14 Identification of male-specific compounds of *Paramoeocerus barbicornis* (Coleoptera: Cerambycidae)

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Paromoeocerus barbicornis beetles belong to the cerambycidae family, which is composed by more than 25,000 species, and are widely distributed in South America, occurring mostly in the south region of Brazil and Argentina. *P. barbic*ornis are boring beetles, feeding and reproducing in *Acacia decurrens*, where the females lay their eggs and the larvae feed by boring in the tree branches, leading to the weakening of tree or boring into untreated lumber, which causes loss of the wood. The female and male volatiles were analyzed by GC-MS and GC-FTIR. The GC-MS analysis indicated four male specific compounds, FTIR analysis presented similar spectra for all compounds, with a band at 1738 cm-1, characteristic for esters. MS spectra indicated the alcohol portion of the structure as C16 and C18 linear chains, and the acidic portions are related to acetate for compound 1, butyl for compound 2 (base peak at m/z 57) and isobutyl for compounds 3 and 4(base peak at m/z 89). To confirm the structures of the compounds, synthetic routes based on hexadecanol and octadecanol esterification were proposed. For determination of the activity, Y olfactometer bioassay employing the synthetic compounds as well as the insect extracts will be performed, in order to study the functionality of the compounds.

P-15 Synthesis of four components of the sex pheromone of the *Spodoptera frugiperda* (Lepidoptera: Noctuidae)

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The *Spodoptera frugiperda* is a prominent pest in attacking grain crops in different regions of the America, mainly affecting corn crops in tropical and subtropical areas, causing economic impact on the continent. In Brazil, besides the control with the use of chemical insecticides, among the methods practiced to inhibit the infestation of this pest, is the use of traps with synthetic pheromones for its monitoring. Four compounds with potential pheromonal activity were found in extracts of females, which are (Z)-7-dodecenyl acetate, (Z)-9-dodecenyl acetate, (Z)-9-tetradecenyl acetate and (Z)-11-hexadecenyl acetate. In this work, the synthesis of these components was realized to elaborate a method for the preparation of the products for later field trials. Because there is considerable structural similarity between these final products, with the presence of a double bond in the chain and all with the same configuration, have the same chemical functionality (acetate) and are aliphatic chain, these products were prepared from same synthetic route, altering only the reagents and reaction intermediates involved. The route used was composed of 6 steps, using α,ω-diols as starting reagents, from which the corresponding bromoalcohols were prepared with HBr. The second step consisted in protecting the alcohol function in these intermediates with dihydropyran (DHP). This was followed by treatment with n-butyllithium for coupling with terminal alkynes with carbon numbers appropriate to form each desired product. The alkyne formed in the coupling step had its acetal group hydrolyzed with p-TSOH to form the alcohol and then partially hydrogenated with the Lindlar catalyst to give the cis alkene. The last step consisted of the acetylation of these unsaturated alcohols, forming the final products.

P-16 Identification of the defensive compounds presents in the dorsal abdominal glands and metathoracic glands of *Antiteuchus sepulcralis*

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Insects perform the exoskeleton exchange as a function of their growth. In this ecdysis process, stink bugs promote detachment of the epidermis, known as exuviae. Due to the transfer of compounds from the dorsal abdominal glands (DAGs) to the exuviae, volatile compounds are found in this material. Pentatomid nymphs produce defensive secretions with strong odors in the dorsal abdominal glands (DAGs) and in adults; these secretions are produced in the metathoracic gland (MTG). This research aims to extract, identify and compare the compounds found in the DAGs of the five nymphal instars and the MTG in the adult phase of the species *Antiteuchus sepulcralis* (HEMIPTERA: PENTATOMIDAE). Exuviae were collected after each instar exchange and, through dissection; the metathoracic gland was extracted from the adult insect and kept in hexane. Analysis were carried out in a gas chromatograph coupled to mass spectrometry (GC-MS), and through mass spectra analyses and Kovats indices determination, aliphatic hydrocarbons, aldehydes and oxo-alkenals were found, similar to those of other pentatomid species. Through this work, it was possible to determine volatile compounds of interest present in glands of the species *Antiteuchus sepulcralis*. In this way, it makes possible the more comprehensive characterization of species of the Pentatomidae family.

P-17 The male-produced sex pheromone of a seed beetles: *Sennius leptophyllicola* (Coleoptera: Chrysomelidae: Bruchinae)

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*Sennius leptophyllicola*Ribeiro-Costa & Costa have been reported attacking fruit valves of *Cassia leptophylla* Vogel, this is an ornamental and urban afforestation plant used in Southern of Brazil. The goal of this work was to study the chemical communication in the species *S. leptophyllicola*. Beetles were collected from fruit valves of *C. leptophylla*, which were kept in the laboratory until the emergence. Volatiles collection were performed in a headspace glass chambers (24 ± 2 °C, 12:12 h L/D). Extracts were analyzed by GC-MS (Shimadzu QP-5050A), with a DB-5 capillary column. Attraction assays were performed with a male crude extract from headspace volatiles collection from 72 h. One male equivalent from the male extract was used in a binary choice Y-tube olfactometer with 1-4 days old virgin females (n=30). GC-MS analysis showed four male specific compounds with features of short chain carboxylic acids. The follow features could be observed: Compound 1, Retention Time (RT): 7,06 min Retention Index (RI): 972, *m/z* 140; Compound 2, RT: 10,058 min RI: 1163, *m/z* 148; Compound 3, RT:11,500, RI: 1262, *m/z* 158; Compound 4, RT 12, 867 min, RI: 1359 and *m/z* 172. Compound 4 is related to **C_{10}**straight chain carboxylic acid. The fragmentation pattern of compounds 1 to 3 suggests unsaturated structures and a methyl branch in each of the three compounds. For confirmation of the instauration geometry, GC-FITR analysis and microderivatization will be performed in order to determine the position of the instauration. For the position of the methyl branch, derivatizations will be performed. Assays showed a high attraction of females to male crude extract in Y-tube olfactometer, 70% of responses. Carboxylic acids have been found as sex pheromone in other Bruchinae species as *Callosobruchus chinensis* L., *C. maculatus* (F.) and *C. analis* F.

P-18 Identification of the alarm compounds produced by the stinkbug *Antiteuchus macraspis*

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Currently, Brazil is one of the largest soybean producers in the world and according to the National Supply Company (CONAB), the annual growth is expected to reach 116.9 million tons of grains. Among the problems faced by soybean farmers, phytophagous bugs are the most important pest group for this crop in Brazil. The aim of this work was to investigate the chemical profile of the defensive compounds released by the stinkbug *Antiteuchusmacraspis* (HEMIPTERA: PENTATOMIDAE). Thus, adult insects were collected on tropical almond trees (*Terminalia catappa* L) in Ilhéus, Bahia, Brazil. The insects were maintained in plastic cages at 25 °C and 75% relative humidity, and the colony was reared with soybean seeds, green beans and tropical almond leaves. The metathoracic glands (MTG) in adults of both sexes and the dorsal abdominal glands (DAGs) contents in nymphs were characterized and quantified by gas chromatography coupled to mass spectrometry (GC-MS) technique. Among the compounds found, saturated and unsaturated aliphatic hydrocarbons, unsaturated aldehydes and oxo-aldehydes were identified. Also, it was possible to observe qualitative and quantitative differences between the compounds present in the DAGs and the MTG content.

P-19 Synthesis of the sexual pheromone of the cigarette beetle (*Lasioderma serricorne*)

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A current strategy in pest monitoring and/or control is the use of pheromones, which is based on a safe environmental management approach, considering it does not cause damages to the environment and human beings.
The specie *Lasioderma serricorne* (Coleoptera: Anobiidae), popularly known as cigarette beetle, is present in tropical, subtropical and temperate regions of the world. It is the major pest for cured tobacco leaves, but it has no preference, it also attacks stored grains, such as: dry fruits, grains, bran, flours and animal food.
In the present work a new route for the total synthesis of 7-hydroxy-4,6-dimethyl-3-nonanone (sexual pheromone of *L. serricorne*) is described, it was performed in six steps. The first step consists in the monobromination of 2-methyl-1,3-propanediol with HBr, under reflux, then it was carried out an oxidation to form 2-methyl-3-bromopropanal, which was subsequently subjected to a Grignard reaction with EtMgBr, yielding 1-bromo-2-methylpentan-3-ol, this had its hydroxyl protected with DHP. The fifth step is a coupling between 2-(1-bromo-2-methylpentan-3-yloxy)-tetrahydropyran and 3-pentanone using LDA. In the last step the deprotection of the hydroxyl occurred, forming the desired pheromone. The proposed route presented satisfactory yields and the products of each step were confirmed by the GC-MS and NMR techniques.

P-20 *Diatraea saccharalis* (Fabricius, 1794) (Lepidoptera: Crambidae) sexual behavior and reproductive success in laboratory

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Borers of *Diatraea* genus cause considerable damage to cane crops in colombian panela (non-centrifugal cane sugar) producing regions. Due to the wide distribution of the species *Diatraea saccharalis* and the geographical variation of the composition of its sex pheromone, the aim of this work was to understand the sexual behavior and the reproductive success of *D. saccharalis*. Calling behavior of 1 and 2 days old virgin females, and 1 day old virgin adults copula behavior and reproductive success, were evaluated during two scotophases under controlled conditions of temperature, relative humidity (25 ± 2 °C, and 60 ± 10% of RH) and photoperiod 12h(D):12h(L), in Agrosavia C.I. Tibaitatá Entomological Laboratory located in Mosquera (Cundinamarca, Colombia). Calling behavior was evidenced from the sixth hour of scotophase for females of 1 day old and from the seventh for females of 2 days old, the calling was maintained until the tenth and twelfth hours respectively, there were no statistically differences between the ages. Calling duration varied in ranges between 30 and 240 minutes, although there was no statistically difference between treatments, the highest percentage of 1 and 2 days old females calling was for 30 minutes. 62% and 50% of 1 and 2 days old females called once, respectively, 19% did not call and 25% called three times. The mating beginning was from the sixth hour and remained until the eleventh hour with a duration between 60 and 150 minutes. 100% of couples copulate only once. The eggs hatching percentage was 75.2%. Survival of the larval stage was 66.5%, pupa 86.5% and adults 97.1%. New studies will be carried out to know colombian populations borer sexual pheromone composition.

P-21 Effect of *Eupatorium buniifolium*, a varroacide essential oil, on survival and pheromone production in *Nosema*-infected honeybees

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Homeostasis in honeybee colonies depend, among other factors, on semiochemicals such as cuticular hydrocarbons (CHC), which are involved in social recognition, and ethyl oleate (EO) which plays a role as primer pheromone in honeybees. Those semiochemicals could be affected by many factors including in-hive acaricides and the gut parasite, *Nosema ceranae*. We have shown that the essential oil from *Eupatorium buniifolium* (Asteraceae) had activity against *Varroa destructor* (Mesostigmata: Varroidae), without chronic effects on survival, EO and CHC production in healthy honeybees. In this work, the effect of the essential oil ingestion on the above variables on *Nosema*-infested honeybees are reported. Essential oil was offered to 2-day old honeybees for 12 days in bioassays following the guidelines recommended by The Coloss Beebook. Healthy honey bees fed on *E. buniifolium* essential oil did not change their EO levels compared to control bees (ANOVA, GLM, $p = 0.02$). On the other hand, *N. ceranae* infection not only decreased, as expected, the survival of honey bees (Survival analysis Kaplan-Mayer) but also EO levels (ANOVA, GLM, $p = 0.04$). However, *Nosema*-infected bees fed on *E. buniifolium* essential oil exhibited a similar EO level to the one in healthy control honeybees (ANOVA, GLM, $p > 0.05$, Tukey post-hoc comparisons). In the case of CHC, variations were found for linear alkanes (ANOVA, GLM, $p = 0.03$), and not for the other CHC classes (ANOVA, GLM $p > 0.05$). Considering all these results together, we came up to the conclusion that *E. buniifolium* essential oil can be used in concentrations below 3000 ppm to treat *Varroa*-infested honeybees without affecting neither their survival nor their EO or CHC levels in healthy hives. When *Nosema*-infested honeybees are fed on *E. buniifolium* essential oil, the decrease of EO level produced by the infection is counteracted by the essential oil consumption.

P-22 Antifeedant and olfactory response of horn flies (*Haematobia irritans*) to blood from steers fed with tall fescue infected by endophytic fungus *Neotyphodium coenophialum*

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The horn fly, *Haematobia irritans*, is an obligate bloodsucking ectoparasite of cattle and is the major global pest of livestock production. Currently, management of *H. irritans* is achieved using broad-spectrum insecticides. However, because of the development of resistance, alternative control methods are necessary. We have described an indirect insecticidal effect upon *H. irritans* when cattle grazing on tall fescue pasture *Neotyphodium coenophialum* infected. Also, we demonstrated that peramine and lolitrem B from *N. coenophialum* were transferred to cattle feces, producing an insecticidal effect on larvae and pupae. However, information about loline alkaloids in cattle tissues and their effect on adult flies is scarce. Here, we evaluated the loline alkaloids presence in blood of steers fed with *N. coenophialum*-infected tall fescue (E+) and we determined the antifeedant and behavioural effect of blood (E+) on horn flies. Seven steers were fed during 21 days on tall fescue pasture (E+) and endophyte-free tall fescue pasture (E-). Blood (E+) and (E-) were sampled at the end to the field essay. Horn flies were collected from steers without treatment. The alkaloid extracts from blood samples were obtained by acid-base extraction and the loline alkaloids presence was evaluated using GC/MS. Antifeedant conduct from horn flies was tested according to Zhu *et al* (2015) and olfactory response was evaluated using a Y-tube olfactometer. Blood (E+) extract showed an unknown single loline. Nevertheless, their fragmentation pattern was characteristic for loline alkaloids. In the antifeedant essay, 95.2 ± 4.8% and 95.8 ± 4.2% of the flies fed from blood (E+) and (E-) respectively. In olfactory studies, 56.25% of flies chose blood (E+) and 43.75 % chose blood (E-). Thus, the presence of the unidentified loline alkaloid in cattle blood produce no significant difference in antifeedant and olfactometric behaviour of horn flies.

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P-23 Chemical Ecology of *Membracis foliata* (Hemiptera: Membracidae) Nymphs

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Membracis foliata (Hemiptera: Membracidae)is a potential pest for some agricultural crops of commercial importance in Brazil, as cocoa and soursop. The attacked plants present deformations that make difficult the translocation of the sap, causing the death of the tissues. The females carry out the endophytic posture, facilitating the entry of phytopathogenic agents into the plant. The new fruits, beyond the deformation, present cracks, causing losses in the commercial value. Besides its importance, to date the studies on Chemical Ecology of *M. foliata* are still scarce. Because of the *M. foliata* gregarious behavior and the adult females capacity of (exhibit) parental care over the eggs and nymphs, the goal of this work was to extract and identify the cuticular compounds of the nymphs. For this, *M. foliata* adults were collected on "tropical almond" (*Terminalia catappa*) and taken to the laboratory for rearing. Postures of the collected adults were observed until the nymphs' hatching. In each instar change, exuviae were collected and the cuticular compounds extracted in hexane. GC-MS analyses of exuviae extracts showed four compounds; two aldehydes and two alcohols with long carbon chain. The biological function of these compounds is still being evaluated.

P-24 Oviposition deterrent activity of *Anastrepha fraterculus* (Diptera Tephritidae) feces

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Tephritid flies are one of the most important fruit pests in the world. After oviposition, females of *Anastrepha fraterculus* deposit host marking pheromones (HMPs) that reduce the probability of further egg laying events. HMPs were isolated in other *Anastrepha* dissolving their feces in water. The rejection of fruit as oviposition substrate caused by HMPs has generated interest as tools for pest management. In order to promote the development of non-contaminant control methods, we evaluated the effect of *A. fraterculus* feces on the behavior of conspecific females.

Feces were dissolved in water and the solution was used in the following experiments. Behavioral recordings: two cylindrical slices of pear (2 cm in diameter and with their rinds intact) were placed in a Petri dish. One of the slices was treated with the solution and the other was treated with distillated water (control). The Petri dish was introduced in a glass container that housed one mated female. The slice visited and the occurrence of oviposition were recorded. Oviposition patterns: groups of 4 mated females were offered oviposition substrates (vials filled with colored water with a lid made of Parafilm). Half of vials was treated with the solution and the other half was treated with distillated water (control). The number of vials that were accepted for oviposition and the number of eggs laid were recorded.

In the behavioral assay, treated slices of pear were less frequently visited than control slices. Moreover, females rejected to lay eggs more frequently on treated slices. In the Oviposition patterns experiment, females laid less eggs in treated substrates, and these substrates were chosen less frequently for oviposition.

Results suggest that the feces of *A. fraterculus* contain compounds that trigger oviposition deterrence. Further studies on the chemical composition of the solution would allow the identification of the compounds that constitute the HMP of *A. fraterculus*.

P-25 *Monalonion bondari* (Hemiptera: Miridae) in his defense art

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Monalonion spp. (Hemiptera: Miridae) is a genus of great importance for cocoa crops in several countries. Adults and nymphs feed on the sap of fruit and terminal branches, where release toxins that kill the tissues. In the fruits, the damages are easily recognized, because they cause pustules that, when in excess, reduce the quality of the almonds or even death of the fruits. In the Bahia state, Brazil, *M. bondari* is responsible for the sharp drop in cocoa productivity and can even decimate productive areas. The nymphs, when threatened, invert the abdomen downwards, releasing a sticky substance, yellowish and with a strong odor. The aim of this work was to study the chemical ecology of *M. bondari*, bringing the first information regarding the defensive behavior of the species. Nymphs were collected directly from cocoa fruits in Mutuípe municipality, in the Bahia state, Brazil. In the laboratory, nymphs were stressed by successive touch with tweezers, and the excreted compound was collected and transferred to 1.5 mL vial with 150 µl of bidistilled hexane. Gas-chromatography coupled to mass spectrometry (GC-MS) analysis was performed and the results showed a mixture of terpenes, which may have been sequestered by the nymphs from sap absorption. Among the compounds, sabinene is the major component and other secondary compounds have been found. More studies are needed to analyze the behavior of chemical signals recognition by endangered nymphs.

Keywords:Chemical ecology, GC-MS, Pheromones.

P-26 Study of the feeding behavior of *Hylastinus obscurus* (Coleoptera: Curculionidae) against a diet composed of roots of an experimental line and a cultivar of red clover (*Trifolium pratense*)

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Hylastinus obscurus is the main insect pest associated to red clover. An average of 1.5 *H. obscurus*/plant can cause 5.5% reduction in forage yield in 2-3 year-old pastures and infestation levels can reach 70%-100%. To date, there is no a chemical strategy for controlling this pest, therefore alternative strategies are a high priority for red clover producers. In the last decade, there has been increasing interest in investigating the impact of flavonoids on insects, specifically for pest control. Previous investigations have established: 1) the potential use of formononetin as an antifeedant on *H. obscurus* and 2) the experimental line Syn II Int V produces a phagostimulant effect on the curculionid. However, we do not know if it is possible to change the feeding behavior of *H. obscurus* by increasing the content of formononetin in the experimental line? The objective of this work was to evaluate the variation of effect phagostimulant of the experimental line Syn II Int V on *H. obscurus* by combination with a cultivar high in formononetin. The feeding assays were carried out using lyophilized root of Syn II Int V (phagostimulant) and the cultivar Sabtoron High (antifeedant). 0.1 g of root (of each and in combination) was placed into transparent Eppendorf tubes ensuring homogeneous distribution. Subsequently, three pre-weighed adults of *H. obscurus* were introduced into each tube and were allowed to feed on the diet for 5 d under darkness at room temperature. After this period, were removed from the tubes and weighed again. The results show that by increasing the content of the Sabtoron High cultivar over Syn II Int V, *H. obscurus* is able to change its feeding behavior from phagostimulant to antifeedant. This information could help farmers and breeders to reduce *H. obscurus* in grassland, selecting ecotypes with high content of formononetin in the roots of red clover plants.

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P-27 Antifeedant effect of plant-produced silver nanoparticles on the feeding behaviour of *Sitophilus zeamais* (Coleoptera: Curculionidae)

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Sitophilus zeamais is one of the most serious cosmopolitan pests of stored cereal grain causing estimated losses of 5-10% worldwide. The curculionid attacks grains in the field and its infestation is carried into the store where it continues its destructive activities. To minimize these losses, chemical pesticides are commonly used in order to protect the seeds during storage. Because of the problems associated with the use of synthetic insecticides, including environmental degradation, development of resistance and residues in food, there is growing interest in search new alternatives of control, "friendly" to the environment. In this sense, the synthesis and use of nanoparticles from native plants is currently a significant area of research, for an eco-friendly approach and green materials. Silver nanoparticles are especially popular because of their antimicrobial properties against bacteria and fungi. However, its effect on insect behaviour has been little studied. In Chile, one of the main sources of silver nanoparticles corresponds to *Galega officinalis* (Fabaceae), a weed widely distributed in the central-southern zone. Therefore, the objective of this research was to evaluate the effect of silver nanoparticles extracted from *G. officinalis* on the feeding behaviour of *S. zeamays*. The methodology was divided in two steps: 1) biological synthesis of nanoparticles from *G. officinalis* and 2) evaluation in artificial diet. To perform the bioassays, the insects (removed from the corn grains) were weight and placed in transparent glass tubes with artificial diet (with and without the addition of nanoparticles) which were maintained in a vertical position during 5 days. Finished the bioassay, the insects were again weighed and their weight gain (%) was obtained. Preliminary results indicate that *S. zeamais* showed antifeedant behavior against a diet composed of silver nanoparticles. This information will provide an understanding of the role of silver nanoparticles in futures control pest.

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P-28 Evaluation of three new dispensers for mating disruption against *Lobesia botrana* (D.& S.) (Lepidoptera: Tortricidae) in a Chilean vineyard

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Three new formulations of dispensers developed for mating disruption (MD) against *Lobesia botrana* (LB) were evaluated in central Chile during 2017-2018, in an infested vineyard were MD was never used before. Dispensers were used at 250 or 500 units/ha, and pheromone loads ranged between 160 and 320 mg of E7, Z9-dodecadienyl acetate/dispenser. Installation of traps was conducted by mid-September, and dispensers were installed by mid-October. A randomized block design was used based on a LB population gradient within the field. The field trial included four treatments and three plots/treatment (2-3 ha ea.); three with dispensers and a check untreated with MD but sprayed 6 times with insecticides targeting LB, during the season. Trap captures (weekly from September to April) and damage (% infestation) on bunches after each flight, were evaluated. Trap shutdown and disruption index (DI) were estimated. DI was calculated by flight and for the whole season. Results demonstrated almost instantaneous trap shutdown after dispenser installation, and DI was always above 96 %. No damage on bunches occurred in pheromone-based treatments, but infested bunches in check plots reached up to 6%. Additionally, the % of bunches with Botrytis fungal infection ranged between 0 and 24% in pheromone treated plots, and between 0 and 78% in check plots. Results confirm the three new formulations satisfy traditional parameters used to test MD dispensers under the Chilean regulation, but a new season is necessary to achieve registration for these commercial products.

P-29 Insecticidal activities from leaves and seeds protein extracts of *Moringa oleifera* lam

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Insects of agronomic importance are one of the limiting factors to the success of agriculture. Among the species of economic importance are *Drosophila suzukii* and *Tibraca limbativentris*. Synthetic insecticides have been used for the control of insects. However, the resistance acquired and the high toxicity of these compounds to the environment and non-target organisms have led to an increase in the search for products from natural origin and effective in controlling insects. In this work we analyzed the effects of protein extracts from leaves and seeds from *Moringa oleifera* on the repellency and survival of *Tibraca limbativentris* (stink bug) and the emergence of *Drosophila elanogaster* and *Drosophila suzukii*. It was observed a possible leakage behavior of the Tibracas, where the percentage of insects at the bottom of rice plants during the first 24 hours in treatments of leaves extract (10%) and seed extract (21.3%) were different from the control (0%). The repellency bioactivity of the treatments was confirmed in the first 24 hours. The data of the bioassays revealed that the survival of *T. limbativentris* was different among the treatments, with a higher mortality at the end of the 192 hours in the leaf extract (20.9%) when compared to the seed extract (10,4 %) and control group (4%). The different extracts of *M. oleifera* affected the emergence of *D. melanogaster* and *D. suzukii*. The highest dose tested of leaf extract significantly affected the survival of both Drosophila, promoting a mortality of approximately 50% in *D. melanogaster* and *D. suzukii*. Foliar protein extract from *M. oleifera* showed insecticidal activity against *T. limbativentris*, *D. melanogaster* and *D. suzukii* and its mechanism of action probably involves the presence of toxic protein and antinutritional. Thus the protein extract of the moringa becomes a good candidate for the control of insect.

P-30 Attractants and types of traps for evaluation of plantain weevils (Coleoptera: Curculionidae) in small farm producers in Cundinamarca department, Colombia

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Plantain production in Cundinamarca, Colombia, is characterized by association with coffee crops, in areas under 5 ha, which are little technified, and are affected by the weevil complex *Cosmopolites sordidus* (Germar, 1824), *Metamasius hemipterus* (Linnaeus, 1758) and *M. hebetatus* (Gyllenhal, 1838) (Coleoptera: Curculionidae). The aim of this work was to evaluate management alternatives for this weevil complex. Two trials were carried out in Viotá and Chaguaní (Cundinamarca). In the first trial (Viotá), the attraction effectiveness of Cosmolure® and Metalure® pheromones using sandwich type traps was evaluated in a randomized complete block design (RCB) with 6 treatments and 5 blocks by weekly evaluations during 3 months. In the second trial (Chaguaní) attractants were compared: pheromones vs fermentation (mature plantain) and gallon traps vs sandwich traps, in a RCB, 6 treatments and 5 blocks during 6 weeks. The average number of individuals captured in treatment was calculated and an ANOVA was performed with a significance level of 0.1 and Tukey multiple comparison tests were conducted for the treatments. In the first trial, the results showed that there was greater capture of *C. sordidus* (13.8 individuals, p=0.0680) and *M. hebetatus* (2.3 individuals, p=0.0234) when insecticide was used in combination with Cosmolure® and Metalure®, respectively, and higher compared to the control with average catch of one individual per trap. The second trial, showed differences between treatments for *C. sordidus* with the sandwich + Cosmolure® (2.13 individuals, p = 0.0120), for *M. hemipterus* with fermentation + Metalure® (3.1 individuals, p = <0.0001) and for *M. hebetatus* with gallon trap + Metalure®(1,03 individuals, p = 0.0020). In both tests, the sandwich trap had a higher catch of the weevil complex and is proposed as a control alternative to be used by small plantain producers due to its low investment of time and money.

P-31 Survivorship of sterile males of *Ceratitis capitata* exposed to the essential oil of *Schinus Polygama*

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The Sterile Insect Technique (SIT) is widely used for the control of the Mediterranean fruit fly (medfly), *Ceratitis capitata* Weidemann (Tephritidae), a worldwide pest causing important economic losses. SIT programs rely on the survival of the sterile males released as well as on its capacity to compete against wild males for wild females. The essential oil from roots of *Zingiber officinale* (GRO: Ginger root oil) is used in SIT programs because it improves the sexual competitiveness of sterile males of *C. capitata*. In previous studies we have shown that the exposure of sterile males to the essential oil (EO) of *Schinus polygama* also increases the mating success. The objective of this study was to evaluate whether the exposure of sterile males to the EO of *S. polygama* affects their survival. Taking into account that availability of nutritional resources and density might influence survival; these factors were included in the experimental design. Sterile males of the Vienna 7 (tsl) strain exposed to *S. polygama* (EO), GRO (positive control) and a group control (non-exposed) were tested at two different densities (10 and 30 individuals per experimental unit) and three nutritional scenarios (nor water nor diet, water, water + diet).The mortality was registered daily for seven days. Results showed that males deprived of diet had shorter lifespan ($p<0.0001$). Neither density nor exposure to EOs had significant effects on survival ($p>0.05$). Since the exposure to the EO of *S. polygama* did not affect the survival of sterile males of *C. capitata*, this EO might be a good candidate to be used for SIT programs.

P-32 Identification and annotation of odorant receptors in the great wax moth, *Galleria mellonella* from head transcriptome

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The great wax moth, *Galleria mellonella* Linnaeus, is a ubiquitous pest of honey bee hives, being along with *Varroa destructor* and concern on insecticide persistence, an important threat for honey bees and apiculture. Nowadays, the presence of *G. mellonella* as a pest has been confirmed in 27 countries, and due to the lack of integrated control, high economic losses are shown for the beekeeping industry. In order to enhance our knowledge toward integrated pest management strategies, the objective of this research was to identify and annotate odorant receptors (ORs) of *G. mellonella* from head transcriptome data. The OR identification was through next-generation sequencing of total RNA extracted from female and male heads by Ilumina HiSeq4000 followed by assembly with Trinity software and annotation using ORFfinder and BLAST. Our results suggest the presence of 37 ORs, from which none is present in the pheromone receptor (PR) clade reported for moths. This last, likely related to the specific chemical ecology of *G. mellonella* with a mating process around bee hives. Nevertheless, the OR15 and OR30 appear in an ancestral clade close to the PR clade as well as with high transcript abundance in females than males. These findings suggest OR15 and OR30 as putative PRs for further functional studies.

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P-33 Role of 3-methyl-2-butenyl butyrate in the chemical communication of *Thaumastocoris peregrinus*: analysis of male and female electroantennogram responses

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The bronze bug, *Thaumastocoris peregrinus*, is a hemipteran native from Australia that feeds on *Eucalyptus* trees, accidentally introduced in Uruguay in 2008. The insect causes the loss of photosynthetic area and defoliation in eucalypt trees. In Uruguay, more than 90% of commercial forest plantations are dedicated to *Eucalyptus* species, underlining the need for conducting research in management alternatives for this species. Pheromones represent one option, and in recent years our laboratory has advanced in the study of chemical communication in *T. peregrinus*. Collection and analysis of volatile organic compounds emitted *in vivo* showed the presence of significant amounts of 3-methyl-2-butenyl butyrate, emitted only by males. In addition, our more recent findings show that males in the same rearing conditions exhibit variability in 3-methyl-2-butenyl butyrate quantity, and those males with more compound are more likely to be accepted by females. Also, in experiments with two interacting males and one female, more aggressive and dominant males had almost twice the amount of 3-methyl-2-butenyl butyrate than submissive males. These results suggest a likely role in sexual behavior for this compound, specifically male-male competition. There are yet no reports on the detection capacity of the compound by males and females. Here we present the first report of electroantennogram response of *T. peregrinus* female and male antennae to 3-methyl-2-butenyl butyrate. To do this, we first determined natural levels of male pheromone in isolated males by GC-MS analysis of individual male extracts. Then, we used whole-head glass-electrode preparations and GC-EAD to characterize the dose-response relationship of male and female antennae to 3-methyl-2-butenyl butyrate. These studies are included in a long-term project to investigate the chemical communication system of this forestry pest, with the ultimate goal of developing a sustainable semiochemical-based management strategy.

P-34 Identification and annotation of odorant-binding proteins in the great wax moth, *Galleria mellonella*, from head transcriptome

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Galleria mellonella is considered a worldwide distributed pest of bee hives, being one of the factors that constantly threatens bee colonies and apiculture. *G. mellonella* unlike other lepidopterans presents a process of inverse attraction, where the males emit the sexual pheromones (i.e. nonanal and undecanal). Although this inverse mating process has been reported at behavioural level, no information is available regarding the physiological implications at olfactory level. Such situation can be studied based on odorant-binding proteins (OBPs), which are known to act as carriers of odorants in the sensilla of insects. Considering the above, the objective of this research was to identify and annotate OBPs from the head transcriptome of *G. mellonella* in order to understand the special chemical ecology around the moth at molecular level. Data from next-generation sequencing of total RNA were assembled by Trinity software and homology searches were performed against a database of lepidopteran OBPs using ORFfinder server and BLAST platform. Our results suggest the presence of 20 OBPs, from which 4 are classified as pheromone-binding proteins (PBPs) and 2 as general odorant-binding proteins (GOBPs). Moreover, 15 classical OBPs were determined with multiple alignment by ClustalW. Phylogenetic analysis suggests, through Maximum Likelihood with 1000 bootstrap, evolutionary relationship between PBPs and GOBPs. Finally, most OBPs present a very similar level of abundance in female and male, with the exception of PBP2, OBP1.1, OBP11 and GOBP2 that are more abundant in females. These results provide valuable information of olfactory adaptation of *G. mellonella* considering its chemical ecology.

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P-35 Electrophysiological studies with metasternal glands constituents of *Triatoma infestans* (Hemiptera: Reduviidae). Reinvestigation of MG emission during mating

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Metasternal glands (MG) of *Triatoma infestans* are a pair of exocrine glands ventrally located at the anterior margin of metacoxal cavity. Early works in the study of sexual behavior in *T. infestans*, showed that mating couples release volatiles that attract and aggregate males around them (Manrique & Lazzari, 1995). Subsequent works occluding female MGs orifices exhibited a significant decrease of copulation frequency and males aggregation behavior (Crespo & Manrique, 2007), confirming some kind role in sexual communication. Moreover, GC-MS analyses of volatiles emitted by excised MGs revealed the presence of highly volatile aliphatic ketones, alcohols and a tentatively characterized component according to previous findings as 1,3-dioxolane (Manrique *et al*., 2006; Unelius *et al*., 2010). These components present a potential as sexual attractants applicable to the development of vector control techniques in Chagas Disease (e.g., mating disruption). But until now, GM volatiles could not be detected in the headspace of mating pairs by GC-MS in full scan mode, being detected only occasionally 3-pentanone by selective ion monitoring (SIM) mode.

Here, we returned to this issue and sampled the headspace of a mating pair with a three-phase fiber, and analyzed in full scan mode. Moreover, as it is still unknown which component triggers an electrophysiological response, we carried out GC-EAD and EAG studies using commercial synthetic compounds: 3-pentanone, 3-pentanol, 2-butanone and 2-methyl-1-butanol (purity> 99%).

Volatiles of the headspace of virgin mating pairs collected by DVB/CAR/PDMS fiber were detected in full scan mode by GC-MS and in preliminary experiments almost the same components previously described in the secretion of excised MGs were found in the headspace of a mating pair. However, as relative composition between first collections apparently differed from gland composition, more replicates of HS SPME analysis are needed.

In GC-EAD different antennal segments or multiple antenna were stimulated with MGs synthetic compounds, but no signal could be detected. Instead, EAG results showed a dose-dependent response with all compounds assayed at high range concentrations.

P-36 Experimental lures based in sex pheromone for monitoring *Proeulia auraria* and *Proeulia triquetra* in blueberry crops

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Proeulia auraria, *Proeulia triquetra* and *Proeulia crysopteris* (Lepidoptera: Tortricidae) are endemic and of economic importance as primary and secondary pest in Chile, and of strict quarantine order for Canada, Mexico, Japan, United States, etc.; affecting crops such as blueberry, table grape, grape, apple, among others. Therefore, it requires timely and efficient management. In integrated pest management strategies, monitoring is essential for a good implementation of a control program. In Chile there is no bait to monitoring *Proeulia* spp., so producers lack of relevant information to manage these pests. The only commercially available alternative corresponds to Pherocon TBM® bait, developed for *Platynota idaeusalis* (Walker) (Lepidoptera: Tortricidae), a species not present in Chile. Taking this into account was suggested that specific lures for *P. auraria* and *P. triquetra* based on its sex pheromones would be more attractive for monitoring of adult males of these quarantine pests than the commercial available alternative, Pherocon TBM®. To corroborate this, two parallel experiments were conducted on commercial blueberry orchards in Purranque (Región de Los Lagos) and Parral (Región del Maule); which consisted of three treatments, including the commercial lure Pherocon TBM® (control), and experimental specific lures for *P. auraria* and *P. triquetra*, respectively. Registering *P. triquetra* catches only in the trap with the specific pheromone for this species in both zones. In Purranque, no captures of *P. auraria* were recorded, but *P. crysopteris* was caught in traps baited for *P. auraria*. Observing, greater catches of *P. auraria* with TBM® bait in Parral. Therefore, the lure for *P. triquetra* would be an advisable alternative for producers, above the commercial alternative. While the pheromone for *P. auraria*, was less specific and less effective, requiring more research to improve its performance, considering strategies of specific or multispecies use.

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P-37 Chemical and ecological studies of actinobacteria associated with the stingless bee *Scaptotrigona depilis*

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All living organisms interact in their natural environments, and secondary metabolites play an important role in mediating these interactions. Microorganisms are ubiquitous and establish different types of associations with other organisms, including obligate mutualistic relationships. A well-known symbiosis has been described between Attine ants and actinobacteria for many years. In this association, actinobacteria produce secondary metabolites which specifically suppress the fungal pathogen of the colony with no activity against the mutualistic fungal food source. Interestingly, recent studies have shown that protective association between Hymenopteran insects and actinobacteria seems to be more widespread than previously thought. Other ants, bees, wasps were found to engage in association with actinobacteria that produce secondary metabolites active against fungal entomopathogens. Indeed, actinobacteria have been isolated from brood cells of Trigona bees and from internal Tetragonisca angustula colonies. Our research group has also been studying the association of Brazilian stingless bees with microorganisms. We reported the molecular mechanism underpinning the nutritional mutualism between the stingless bee Scaptotrigona depilis and a fungus that grows inside the brood cells and is ingested by the larvae to complete metamorphosis. However, no protective association between actinobacteria and S. depilis has been described. Therefore, the aim of the current work was to recover actinobacterial symbionts associated with S. depilis and verify their antimicrobial properties. As a result, 130 microbial strains from different colonies and brood cells were isolated, being 26 predicted as actinobacteria. Antagonism assays against pathogenic microorganisms were performed in order to select the most promising actinobacteria strains for further isolation and identification of bioactive natural products. The results showed 10 positive strains against Beauveria bassiana (38.5%), 3 positive strains against Metarhizium anisopliae (11.5%) and 5 positive strains against Paenibacillus larvae (19.2%). Among these, 5 strains were selected and their extracts presented antimicrobial activity against the pathogens. Chromatographic, spectroscopy and spectrometric techniques are being performed in order to isolate and characterize possible bioactive compounds produced by actinobacteria. The compounds will be submitted to biological assays to establish an ecological function, improving our knowledge about this symbiotic system.

P-38 Antimicrobial activity of the actinobacteria *Streptomyces albiaxialis* ICBG1318 associated with the stingless bee *Melipona scutellaris*

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Throughout evolution, insects have established symbiotic relationships with microorganisms that are able to produce bioactive secondary metabolites. These compounds protect the host against pathogens, playing an important role in chemical ecology. As a result of their functional role, these natural products can also perform several pharmacological activities being an important and understudied source of new chemical entities for hit discovery. Based on these evidences, this work aims to study bioactive compounds produced by actinobacteria associated with the stingless bee *Melipona scutellaris*, as part of an ongoing International Cooperative Biodiversity Group (ICBG) project between Brazil and the US. The actinobacteria ICBG1318 was isolated from nurse bee and was selected for chemical studies based on their ethyl acetate extracts activity against the protozoan parasite *Leishmania donovani* (99% of inhibition). This strain was identified by 16S rRNA gene sequencing as *Streptomyces albiaxialis*, described as a thermotolerant and halotolerant strain with poorly explored secondary metabolism. *S. albaxialis* has not been previously reported as a bee symbiont. This strainwas screened against three entomopathogens (*Metarhizium anisopliae*, *Beauveria bassiana* and *Paenibacillus larvae*) and three human's pathogens (*Candida albicans*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*) and showed a good inhibition against the bacteria *P. larvae*, which causes American Foulbrood disease in beehives, and against *S. aureus*, an important human pathogen. *S. albiaxialis* ICBG1318 was cultivated in ISP-2 agar and the bioguided fractionation of ethyl acetate extract by SPE and HPLC led to the isolation of two compounds (VL1 and VL2). Analyses of 1D and 2D NMR data indicate that they are analogous compounds. HR-ESI-MS analyses are being performed to complete structural elucidation.

P-39 Conspecific versus general odorant detection in *Loxosceles laeta*

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Spiders are Arthropods from the Class Arachnida, Order Araneae. In opposite to insects, their physiology and behavior have been poor studied. Up to date, remains unknown if spiders possess an olfactory system and in which behaviors it could be working on. With the aim to show the presence of an olfactory sense in *Loxosceles laeta*, we study the behavior of this species against stimulation with different type of general odorants and conspecific opposite sex spider odors. For this, we designed a behavioral paradigm that uses *L. laeta* given its ecological and epidemiological importance in Chile.
In the present study, we use two different custom-made mazes, with four and two arms. A membrane pump connected by teflon tubing to 10 ml glass vials that are connected to the ends of the maze arms, was used to deliver odorants with a constant flow of air from impregnated filter papers, inserted in the vials. The mazes were covered with glass and mounted in a dark Faraday chamber under infrared illumination. A single *L. laeta* specimen was placed at the center of the maze and its movements were recorded overnight with an infrared webcam. In the experiments with conspecific odor, a vial with an adult live specimen was connected to the maze and one maze arm was perfused by air without odorants as blank control. Time-lapse images were captured and analyzed online with a custom computational algorithm, which allowed faithful tracking of the spider's movement and position. Although general odorants triggered neither attraction nor aversion, conspecific odor of the opposite sex caused aversion in females, and attraction in males. These results support the presence of a specific olfactory system for the detection of conspecifics in *L. laeta*, but suggest the absence of a broadly tuned system for general odorant detection in this species.

P-40 Identification of volatile compounds involved in host location by *Anthonomus grandis* (Coleoptera: Curculionidae)

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Phytophagous insects rely on plant volatiles to locate suitable hosts upon which to feed or oviposit. The boll weevil, *Anthonomus grandis*, is the main pest on cotton crops in the Neotropical region and is attracted to host plant volatiles, especially herbivore-induced volatiles from reproductive cotton. Behavioural and electrophysiological responses of the boll weevil were evaluated aiming the identification of the compounds responsible for host location. We found that ten compounds elicited antennal responses from *A. grandis*, but only six were required to elicit a full behavioural response, namely: (*R*)-linalool, (*E*)-4,8-dimethyl-1,3,7-nonatriene (DMNT), methyl salicylate, (*E*)-(1*R*,9*S*)-caryophyllene, geranylacetone and (*E*-*E*)-4,8,12-trimethyl-1,3,7,11-tridecatetraene (TMTT). A synthetic blend comprising these six compounds was as attractive as the crude sample of cotton reproductive stage volatiles. The identification of cotton volatiles attractive to the boll weevil would facilitate the understanding of boll weevil-cotton plant interactions and the development of alternative methods for semiochemical-based weevil management, e.g. enrichment of aggregation pheromone traps with plant volatiles.

P-41 Maize Specialist, *Dalbulus maidis*, Induces the Release of an Allomone in a Maize Landrace, but not in Maize Hybrids

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Plant defenses against herbivores are predicted to change with domestication and breeding in crop plants. A decisive factor for the susceptibility or resistance of host plants is their ability to recognize a particular herbivore and mount rapid defenses, producing allomones that dissuade future individuals of the pest from feeding.
In this study, we compared the attractiveness of a suite of three maize germplasms representing two domestication and breeding transitions from landrace to modern hybrid cultivar, on a specialist herbivore, the corn leafhopper *Dalbulus maidis* (DeLong) (Hemiptera: Cicadellidae).
Two PIONNER maize hybrids, P1780YR (temperate) and P30B39HR (tropical) and a landrace known as sweet white maize (SWM) were used. Treatments consisted of Non-induced healthy maize plants and plants Induced by the attack of 6 *D. maidis* females (for 12 hs before the assays). Olfactory dual choice tests were performed between Non-induced and Induced plants of each germplasm, using a stationary phase olfactometer, with the odor sources placed in opposite directions (N=40). Statistical differences where determined with Chi-square goodness-of- fit test (χ^2). Plant volatiles were collected and analyzed according to Braccini *et al*. (2015).
Dalbulus maidis preferred Non-induced SWM over Induced SWM (χ^2 = 10.465, P = 0.001), but did not discriminate between Induced temperate maize vs. Non-induced (χ^2 = 0.615, P = 0.433), or Induced tropical maize vs. Non-induced (χ^2 = 0.065, P = 0.799).
Induced SWM produced an indole derivative and homoterpenes which were not produced by Induced temperate and tropical hybrids. At least one of these compounds could be an allomone, responsible for repelling *D. maidis*, that has been lost in the modern hybrids.

Braccini, C. L., Vega, A. S., Coll Aráoz, M.V., Teal P. E., Cerrillo, T., Zavala, J. A. & Fernández, P.C. (2015). *J Chem Ecol*, 41(11), 985-996.

Poster Session II
Thursday, October 25 (17:30-19:00 h)

P-42 Olfatometric analysis of *Xanthogaleruca luteola* (Müller) (Coleoptera: Chrysomelidae) to volatile organic compounds of host-plant, non host-plant species and conspecific individuals

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The elm leaf beetle, *Xanthogaleruca luteola* (Müller) (Coleoptera: Chrysomelidae), is a monophagous species that feeds on the leaves, causing, even, the complete defoliation of the host-plants of the genus *Ulmus* spp.
In order to study the interaction between elm leaf beetle males and females, and its attraction to the host-plant *Ulmus americana* and the non host-plant *Eucalyptus globulus*, adult behavior experiments were conducted using a Y-tube olfatometer.
Our preliminarily results indicate that males are attracted to females, but females are not attracted to males. Females were attracted to both host-plant and non host-plant species, which was not observed in males.
These preliminary results indicate that there are volatile compounds emitted by *X. luteola* females that attract males, and suggest that host-plant and non host-plant volatile compounds might play an important role in the female host-plant selection.

P-43 Who is my adversary? Effect of isomers and enantiomers of pinenes on the mating success of medfly males

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Plant phytochemicals affect the sexual behaviour of Tephritidae fruit fly males. In particular, (-)-α-pinene, a common plant volatile enhances the mating competitiveness of *Bactrocera oleae* males. The objective of this study was to evaluate the effect of exposure to α- and β-pinene on the mating success of *Ceratitis capitata* males. Because it is recognized that enantiomers of monoterpenes have different biological activity, different enantiomers were included in the mating trials. Experiments consisted in exposing *C. capitata* males from a laboratory colony to α- and β-pinene enantiomers and then evaluate their sexual performance in a mating arena. Two experiments were conducted. In the first experiment, one exposed male was caged with one non-exposed male and one female. In the second experiment, competing males were exposed either to α- and β-isomers of the same enantiomer or to enantiomers of the same isomer. The number of mating pairs obtained by each type of male (mating success), the latency to mate and the duration of the copula were recorded for each treatment. Results showed that exposure of males to (-) α-pinene significantly increased the mating success over non-exposed males. Latency to mate was significantly reduced for males exposed either to (+) and (-) α-pinene compared to non-exposed males. In contrast, latency was significantly higher in males exposed to (+) β-pinene than in non-exposed males. Regarding males exposed either to equal enantiomer and isomer, results indicate that within α-pinenes, males exposed to α (+) showed higher mating success than α (-)males. On the other hand, when males were exposed to the same enantiomer, males exposed to β (+) were more competitive than males exposed to α (+), while no significative differences were observed for males exposed to α (-) competing with β (-) males. No statistical differences were found for copula duration. In conclusion, enantiomerism and structural isomerism are important in the mating competitiveness of medfly males exposed to pinenes. Since the mating success of treated males depended on the combination of competing males, it is suggested that a transitive relation among enantiomers or isomers is not fulfilled.

P-44 Is interaction between the Southern red mite *Oligonychus ilicis* and coffee plant affected by infestation of hetero-specifics?

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Plant upon herbivore attack have signalling pathways triggered and induced defense mechanisms activated. Depending on the herbivore feeding guild attacking the plant, a given signalling pathway is activated, while another is suppressed, a phenomenon known as negative cross-talk. Therefore, the plant can become susceptible to a second herbivore particularly from a different feeding guild, resulting in multiple infestation of herbivores, a common scenario in natural environments. Despite of that, the literature still lacks information regarding the behavior of a second arrival on hetero-specific-attacked plants. In this context, the aim of this study was to evaluate host preference and performance of the Southern red mite *Oligonychus ilicis* (McGregor) (Acari: Tetranychidae), a piercing-sucking arthropod, in coffee plants (*Coffea arabica* L., Rubiaceae) infested by the sap-sucking insect *Planococcus minor* (Maskell) (Hemiptera: Pseudococcidae), a mealybug. In choice tests, mite females did not discriminate between mealybug-infested and uninfested plants and deposited similar numbers of eggs in both treatments. However, in no-choice tests, mite females deposited more eggs on uninfested plants than mealybug-infested plants. In addition, the Southern red mite showed superior performance when fed on uninfested plants as higher numbers of nymphs, females and males were found on uninfested relative to mealybug-infested plants. A possible explanation for the lack of *O. ilicis* preference is the co-evolutionary relationship between this mite and coffee plants as this specialist arthropod has been adapted to induced plant defense mechanisms. On the other hand, the inferior mite performance in mealybug-infested plants may be associated to the large amounts of honeydew left on the leaf by *P. minor* mealybugs that hampers mite movement.

P-45 Preference-performance of a generalist aphid on two *Solanum* plant species

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In phytophagous insects with no parental care and slow-moving immature stages, female oviposition choice is crucial for the performance of the offspring. Therefore, choosing the right host plant may be an important element of fitness on which selection should play a relevant role. Consequently, it is expected that females have the ability to discriminate between plants and choose one that favors offspring performance. However, several studies have shown that it does not always apply. Among the factors that may modulate the preference–performance relationship, diet breadth is a significant one, showing that generalist insects would have a lower capacity to choose suitable host for oviposition. Here, we evaluated the preference-performance relationship of the generalist aphid, *Myzus persicae* (Hemiptera: Aphididae) on the host plant, the cultivated potato *Solanum tuberosum*, and its wild congener *S. commersonii*. The performance was evaluated in two trials: with whole plant and with leaflets, assessing survival, development time and fertility of aphids on both potato species. The preference was evaluated measuring settlement and larviposition of winged females in a choice bioassay with this two *Solanum* species. The results showed that *M. persicae* did not survive in the wild species; nonetheless females did not discriminate between both *Solanum* to lay offspring. This result provides another evidences that preference-performance would not correlate for generalist insects. The choice of suitable host plant could not be so relevant for insects with a broad diet breadth, since they can compensate it by an access to a great diversity of resources.

P-46 This work is not presented

P-47 Volatile organic compounds from the fungi *Fusarium verticillioides* as natural inductor of maize kernel defense

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The silo is a man-made environment where a large number of biological interactions, such as insect-fungal associations, are produced and these cause significant economic losses. This is the case of the interaction between the maize weevil (*Sitophilus zeamais*) and the maize-infecting fungus *Fusarium verticillioides*. Due to the problems caused by synthetic pesticides, interest has grown in the use of alternative strategies based on semiochemicals such as those derived from communication between attacked plants and healthy neighboring plants, activating the defense system. In this work it is proposed that volatile organic compounds (VOCs) emitted by *F. verticillioides*, could condition healthy maize kernels, increasing the activity of the LOX path, affecting the behavior of *S. zeamais*. In tests of susceptibility to attack of the insect, made in two-way olfactometers in which unconditioned maize grains (control) with conditioned grains (treatment) was observed that, after 20 days, the treatment kernels are less attacked by *S. zeamais*. In a second instance, the LOX activity, from treated and control corn kernels, was measured spectrophotometrically. In these tests, a 1.755-fold increase in the activity of the LOX enzymes of treated kernels with respect to control kernels was obtained. In agreement with this result, when a semi-quantitative analysis of the polypeptide profile of the treated and control maize kernels was made, an increase was observed in the area of the band whose molecular weight corresponds to the LOX enzymes, in conditioned kernels. Finally, the results of gene expression analysis confirmed an increase in the expression of genes coding for LOXs in conditioned kernels with fungal VOCs. Together these experiments allow to suppose an induction of the defense system of maize kernel when exposed to VOCs produced by *F. verticillioides*, suggesting that the kernels could identify these compounds and increase their defense mechanisms and the production of VOCs derived from the LOX pathway.

P-48 Volatile profile of quince varieties (*Cydonia oblonga* Mill.) by damage of codling moth (*Cydia pomonella* L.)

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Quince (*Cydonia oblonga* Mill.) is one of the main fruit crops in San Juan province, Argentina. Codling moth (*Cydia pomonella* L.), a worlwide oligophagous pest generates a great discard of quinces production. The host finding is mediated by volatile compounds released by plants. The fruit profile compounds changes in response to damage by codling moth. The aim of this study was to determine the volatile profile compounds of fruits and leaves at ripening stage, in 6 varieties of quince (Champion, Portugal, Smyrna, INTA 37, INTANDINO 117 and INTA 147). Experiments were conducted at the experimental field of INTA-Pocito (San Juan, Argentina). After the fruit set, branches of the different varieties were protected with fabric bags, to prevent the pest entry. At ripening stage, fruits and leaves of branches exposed and protected of the pest were sampled. Volatile profiles were determined by SPME-GC/MS analyses. Two chemicals groups were observed for the fruits: sesquiterpenes and esters, with 86% and 7% of the average relative area, respectively. In all fruits alpha-farnesene was the main compound, and its content increased in fruits affected by codling moth damage in certain varieties. In leaf samples, the profile was dominated by aldehydes and alcohols, with 54% and 34% of the average relative area, respectively. These results, in a preliminary nature, fill out absent information for quince cultivation and its interaction with codling moth.

P-49 Detection of volatile compounds from pregnant females and eggs of four sand fly species using Solid phase microextraction- Gas Chromatography- Mass Spectrometry (SPME/GC-MS)

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There are about 570 Phlebotomine sand flies identified in South America and a little more than 20 species are vectors of *Leishmania* spp. Chemical ecology studies in sand flies are mainly focused on *Lutzomyia longipalpis* which presents sexual and oviposition pheromones already identified. So far, the methodology used for sex pheromone studies in sand flies was based on direct hexane extraction or adsorbent polymers. This study aims to detect volatiles in pregnant females and eggs of four sand flies species: *Nyssomyia neivai*, *N. whitmani*, *Pintomyia fischeri* and *Migonemyia migonei* usingSolid phase microextraction - Gas Chromatography – Mass spectrometry (SPME/GC-MS). Firstly, several parameters were evaluated like type of coating on the fibers, sampling conditions, number of eggs or females, using *L. longipalpis* as a positive control. The fiber of choice was Divinylbenzene-Carboxen-Polydimethylsiloxane(DVB-CAR-PDMS, 50/30 µm). Pregnant females were used to a) ambient temperature - different number of pregnant females were inserted in sealed vials of 1.5 mL with the fiber and after 12 hours the fiber was stored at-20º C until chromatographic analyses; b) the same sample was heated at 170º C for 45 min and after the fiber was inserted for 45 min before chromatographic analyses. The same methodology above was performed with the eggs to 48 hours after oviposition collected on wet filter paper. Since some results showed that more than 200 eggs are necessary for headspace collection, a direct contact of fibers on surface of recently released eggs (1-10) eggs for 5 min was performed. Over 20 compounds with 90% of similarity with NIST library (confirmed by GC retention indexes relative to n-alkanes C_8-C_{20}) were detected in females and eggs of the sand fly species evaluated; aldehydes were the most common compounds identified. Dodecanoic acid, oviposition pheromone of *L. longipalpis* was detected in three species evaluated.

P-50 Repellent activity of natural origin substances as a strategy of protection and integrated management for *Aedes aegypti* (Diptera: Culicidae)

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Aedes aegypti (L.) is the main vector of some arboviral diseases. One of the first lines of defense that is possible to constitute between mosquitoes and humans is the use of repellents. N,N-diethyl-3-methylbenzamide is a synthetic insect repellent used worldwide to protect people from bites of blood-sucking arthropods. δ-dodecalactone is an aliphatic lactone widely found in vegetable tissues, who has shown to have repellent effect on lice resistant to permethrin. The aim of this study was to evaluate the repellent effect in *Ae. aegypti*females of δ-dodecalactone alone and in combination with DEET (in a non-repellent concentration) through different behavioral bioassays.

In vitro bioassays were carried out in a petri dish (diam.: 9 cm), with a filter paper divided into a treated zone (different concentrations of δ-dodecalactone from 0, 01 to 200 mg/ml in combination with 0,005mg/ml of DEET) and a control zone (acetone). The individual behavior of the females was registered for 10 min and then analyzed with the Ethovision XT video tracking software, which allowed the automated tracking and quantification of the behavior. The repellency index was determined (RI) = [(Tt-Tr)/Tt)] where, Tt is the total time in both areas and Tr is the time in treated zone.

Secondly, in vivo bioassays were conducted on pigeons with a section of skin impregnated with the effective concentrations of δ-dodecalactona (100 mg/ml) and DEET in alcohol, including a positive (DEET 7%) and negative (alcohol) control. The percentage of feed inhibition was calculated as follows FI [%] = [(1−T/C) ×100] where C is the number of females eaten in the control and T the number of females eaten in the treated.

The results showed an effective repellent effect of the δ-dodecalactone and an increased effect in combination with DEET. These studies can contribute to the production of repellents using natural compounds as the main active ingredient.

P-51 A cuticular male-specific compound produced by *Amerrinhus ynca*

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The weevil *Amerrhinus ynca* (COLEOPTERA: CURCULIONIDAE), is known as leaf-borer, and causes damage to the coconut trees. The larvae feed on the tissues inside the coconut petiole and, consequently, damage the development of the plant and cause the reduction of the production. The objective of this work was to verify the sex-specific compounds present on the cuticular surface of both sexes of *A. ynca*, aiming to identify the compounds that can act as sex pheromone of this species. For this, coconut petioles containing *A. ynca* pupae and larvae were collected in Una municipality, Bahia State, Brazil, and sent to State University of Santa Cruz. In the laboratory, the insects were separated by sex through the difference of the abdominal convexity between males and females. From the solvent extraction technique, the cuticular compounds were collected in hexane. The extracts of males and females were analyzed by gas chromatography coupled to mass spectrometry (GC-MS) and the comparison of the chromatograms showed the presence of two male-specific compounds, one also present in volatiles extracts and another found only in cuticle. The first compound was identified as octadecanal, and the MS spectrum of the second one suggested a long-chain methyl-branched ketone. The structure elucidation and the bioactivity verification of this compound are underway.

P-52 Arrestment pheromone on the tropical lineage of *Rhipicephalus sanguineus* sensu lato

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The aim of this study was to investigate the presence, role and identity of the arrestment pheromone for *Rhipicephalus sanguineus* sensu lato tick. Excreta and exuvia of larvae and nymphs were collected, solubilized in NaCl, agitated in a vortex and the extract then reduced in volume under N_2 air. Bioassays were carried out to test the response of *R. sanguineus* s.l. to the extract and solvent, using a climatic chamber (RH95%, T30ºC) that divided into six equal sectors containing a filter paper (1 x 4 cm) that was either untreated or treated with extract or solvent. Each test consisted of 10 adults, 10 fed or 10 unfed nymphs released in the center of the filter paper. The position of the ticks was observed 1, 2 and 24 h after the beginning of the bioassay. Ten replicates were performed. Data were log transformed prior to analysis by paired *t* test.Adult ticks were arrested on theextract after 2 h, with an increase in arrestment after 24 h. Unfed nymphs arrested at all times. However, engorged nymphs were not arrested at any time, and ticks did not arrest in response to the solvent evaluated. Chemical analysis suggested the presence of many compounds, mainly fatty acids, and a purine-like compound, potentially similar to purines that have been identified as the arrestment pheromone of other ticks. The results presented here suggest that purines might also comprise the arrestment pheromone of the tropical lineage of *R. sanguineus* s. l. As it is known that this tick species can be managed by the use of repellents from less-preferred hosts, the knowledge here could potentially underpin the development of a push-pull approach for tick management through simultaneous deployment of repellents and the pheromone.

P-53 Synthesis and field test of the sexual pheromone of *Opsiphanes invirae* Hübner (1808) (Lepidoptera: Nymphalidae)

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The attack of *Opsiphanes invirae* on coconut, palm oil, açai and banana crops causes great economic damage due to defoliation of plants and reduction of production. Control of *O. invirae* is carried out with traps in plastic containers containing sugarcane molasses concentrated or diluted in water.
In the laboratory, extracts of volatile compounds obtained from *O. invirae* were analyzed by GC-FID and GC-MS and the structure of the active one was confirmed by comparison to the synthetic compound. The synthesis of (*Z*)-7-heptadecene was performed in three steps. Initially, the alcohol was brominated with HBr, under reflux, to form 1-bromononane in 93% yield. Coupling with 1-octyne, using n-BuLi, provided 79% of 7-heptadecyne, and finally hydrogenation with Lindlar catalyst and hydrogen yielded 87% of the final product. The product structure was confirmed by GC-MS and analysis of uni (^{1}H, ^{13}C) and two-dimensional NMR (HSQC, HMBC and COSY).
Field tests to evaluate the attractiveness and capture of *Opsiphanes invirae* adults with the pheromone formulation were carried out on palm oil plantation at the Agropalma S/A farm, in the municipality of Tailândia, Pará state, from September to October 2017. The traps were prepared in plastic bags containing food attractant (sugarcane molasses) and pheromone. Nine traps were used to test the pheromonal mixture. The pheromone proved to be efficient for mass collection, showing a higher capture rate compared to traps with only the food attractant, currently the most used method to control that pest in the adult phase.

P-54 Synthesis of two components of the sex pheromone of *Diatraea saccharalis* (Lepidoptera: Pyralidae)

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Diatraea saccharalis, known as sugarcane borer, is an important pest in the Americas. When attacking sugarcane crops, their larvae pierce the plant, affecting the production of sucrose. The two main components of its pheromone are (*Z*,*E*)-9,11-hexadecenal, major component, and (*Z*)-11-hexadecenal. (*Z*)-11-Hexadecenal was synthesized from a route consisting of 6 steps. Initially, a bromoalcohol was prepared from 1,10-decanediol with HBr, followed by protection of this intermediate with 3,4-dihydro-2*H*-pyran (DHP). The 1-hexyne was treated with n-butyllithium and coupled with the protected bromoalcohol obtained in the previous step, forming a disubstituted alkyne. This alkyne had its acetal group hydrolyzed to form the corresponding alcohol, 11-hexadecyn-1-ol, which was subjected to partial hydrogenation of its triple bond to form a *cis* alkene. This unsaturated alcohol was oxidized to (*Z*)-11-hexadecenal aldehyde, the final product of this synthesis. The major component pheromone, (*Z*,*E*)-9,11-hexadecadienal, had its proposed preparation following a route with 7 steps. Its synthesis has been partially completed to the present moment and is still in development. Initially, a bromoalcohol was prepared from 1,8-octanediol, which was protected with DHP. This intermediate was reacted with lithium acetylide in DMSO to form a functionalized terminal alkyne. This alkyne was coupled in the next step and the corresponding product will be subjected to the transformations necessary to give the final product, according to the proposed synthetic route.

P-55 Evidence for an aggregation pheromone produced by the weevil *Heilipus catagraphus* (Coleoptera: Curculionidae)

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Heilipus catagraphus is considered an important pest of soursop (*Annona muricata*) and avocado (*Persea americana*) in Brazil. The larvae make galleries in the trunk of the plants, affecting the production and, in some cases, leading the plants to death. Methods of control for this weevil that are efficient and harmless to the environment lead to the use of synthetic pheromones. In this way, this work aims to identify the aggregation pheromone of *H. catagraphus*. The chemical compounds present on the cuticle of males and females were extracted and analyzed by gas chromatography. Comparing the chromatograms, it was possible to observe six compounds produced exclusively by the males of this species. Electroantennography analyses showed that compound 2 was bioactive on female antennae and olfactometer bioassays showed a preference of *H. catagraphus* males to male extracts, suggesting this compound as a pheromone of this species.

Keywords: Soursop weevil. Avocado weevil. Semiochemicals.

P-56 Identification of the compounds present in the dorsal abdominal glands and metathoracic glands of *Antiteuchus punctissimus* Ruckes, 1964 (Hemiptera: Pentatomidae)

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Stink bugs (Hemiptera: Pentatomidae) are agricultural pests that feed on various parts of plants, causing slicks and decrease of size of seeds and leaves, delay in the foliar maturation, loss of the plants vigor and affecting seed quality. Adults of pentatomids produce defensive secretions in the Metathoracic Glands (MTG) and the nymphs produce these secretions in the Dorsal Abdominal Glands (DAGs). The goal of this work was to identify the defensive chemical compounds present in the DAGs instars and MTGs of adult stink bugs *Antiteuchus punctissimus* Ruckes, 1964. For this, the individuals were collected in tropical almonds (*Terminalia cappata*) trees in the municipality of Ilhéus, Bahia State, Brazil. Through the dissection, the MTGs of adults of both sexes were extracted. The DAGs content of the five instars of nymphs were collected through the extraction in hexane of the exuviae collected soon after the ecdysis. The extracts were then analyzed by gas chromatography coupled to mass spectrometry (GC-MS) and it was possible to identify unsaturated aldehydes, oxo-aldehydes and hydrocarbons compounds.

P-57 Effect of the varroacide *Eupatorium buniifolium* (Asteraceae) essential oil on survival and pheromone production in healthy honeybees

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The essential oil from *Eupatorium buniifolium* (EOEb) has fumigant activity against *Varroa destructor* (Mesostigmata: Varroidae), the ectoparasite that contributes to the honeybee colony collapse disorder and is innocuous to honeybees. These previous observations prompted us to investigate the effect of the ingestion of the EOEb in larva and adult survival and in adult pheromone production. In larvae, the survival after EOEb ingestion at different doses (100 to 1000 ppm) showed no significant differences between treatments and controls (Survival analysis, Wilcoxon Nonparametric Distribution Analysis, $P = 0.657$). In adults, the EOEb was supplied in the diet for 12 days to 2-day old honeybees. Food consumption was not different among honeybees fed with the EOEb at different doses (300 to 6000 ppm) and the control honeybees (ANOVA, $p < 0.01$); neither was the survival among groups (Survival Analysis Kaplan-Mayer, $P > 0.05$).
Ethyl oleate (EO) is a primer pheromone that regulates the worker behavioral changes and that has been reported to change under stress conditions. The cuticular hydrocarbons (CHC) act also as a pheromone involved in social recognition. At the end of the assay, both pheromones were quantified by GCMS. Honeybees that had consumed the EOEb exhibited similar titers of EO as control honeybees (ANOVA, GLM, $P> 0.05$). However, when comparing honey bees fed on the EOEb diet to the control ones, CHC differences (ANOVA, GLM, Tukey post-hoc pairwise comparisons, at the higher doses tested) were found for linear alkanes ($p = 0.019$), branched alkanes ($p = 0.012$) and alkenes ($p = 0.01$). However, up to 3000 ppm of ingested EOEb, either of the CHC groups showed no differences compared to the control bees.
These results point to the *E. buniifolium* essential oil as a good candidate to develop a botanical acaricide in doses lower than 3000 ppm.

P-58 Task allocation in the honeybee: differences in odor sensitivity between pollen and nectar foragers

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Division of labor and task allocation are prime enablers in the ecological success of social insects. In honeybees, differences between foragers collecting nectar and pollen are determined by the sensitivity to different gustatory stimuli (e.g. sugars). Furthermore, pollen foragers might also be more sensitive to odors, including subtle pollen volatiles that elicit foraging behavior. In this study, we aim to determine how forager sub-castes detect, perceive and learn odor stimuli, as these processes might enable the proper assessment of pollen resources. We used electroantennogram recordings (EAG) to compare the electrical response of the antennae in pollen and nectar foragers elicited by increasing concentrations (0.001; 0.01; 0.1; 1 M) of two floral odors: linalool and nonanal. Volatiles from bee-collected pollen loads were also registered. To correlate detection at the antennae with perception in individual bees, foragers were conditioned to different concentrations of the pure odors using the proboscis extension response (PER), a reflex used to condition restrained bees with sugar as reward. In this context, we performed five-conditioning trials where olfactory sensitivity was assessed by the response to the first odor-presentation before reward ("spontaneous response"). At the sensory level, we reported higher signal amplitudes in the antennae of pollen foragers than in nectar foragers for all the odors including volatiles from pollen loads. Differences were better detected at lower concentrations for nonanal trials. At the behavioral level, spontaneous responses were similar among experimental groups; however, learning performance was higher in pollen foragers, particularly among those conditioned to linalool. Our results suggest that pollen collection might be based on honeybee´s capacity to detect and respond to odors presented at low concentrations. Yet, it remains elusive if high-odor sensitivity also facilitates recognition and discrimination of pollen olfactory cues among the complex diversity of floral scents emitted by the rest of the flower.

P-59 Temporal variation of floral volatile emission and diurnal visitation of *Oenothera picensis* ssp. *picensis* (Myrtales; Onagraceae)

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Plant species with diurnal and nocturnal anthesis may have different groups of pollinators and also different sets of attractive cues during these two time periods. In this study, we determined the nature and time dependence of floral fragrance emission, as well as the activity pattern of diurnal and nocturnal floral visitors of *Oenothera picensis* ssp. *picensis*,a native species of the coast of central Chile with self as well as outcrossing reproductive capabilities. We surveyed floral visitors (daytime: 09:00 – 13:00; nighttime: 21:00 – 23:00) and collected floral volatile organic compounds (VOCs) in the field (10:00 and 21:00) which were later analyzed by GC-MS. During daytime, we found 11 species of insect visitors belonging to five orders (Hymenoptera, Diptera, Coleoptera, Lepidoptera y Cicadellidae), hymenopterans being the most frequent (86.7%); at night, no visitors were observed. Nocturnal VOC emissions were more complex than diurnal ones; they contained mostly alcohols while diurnal emissions contained mostly esters. We discuss these findings in relation to how floral VOCs emission and the expanded floral anthesis may fit in the context of mixed-mating pollination strategies with complementary diurnal and nocturnal pollinators.

P-60 Characterization of the antennal sensilla in coconut moth adults

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Many studies have elucidated the morphology of the antennal sensilla of several insect pests. The antenna is the main olfactory organ of the insects, in which are present numerous sensilla with cells, whose function is the detection of odors. In this context, this study aimed to identify the antennal sensilla of *Atheloca sp.*
The scanning electron microscopy (SEM) images used to characterize the sensilla in the coconut moth antenna were obtained from the Laboratory of Instrumental Analysis of the Federal Institute of Alagoas with the aid of the equipment INCAx-act, Oxford-instruments®. The antennae were removed from males and females of *Atheloca sp.* and fixed in 2% glutaraldehyde solution in phosphate buffer of pH 7. Following fixation, the antennae were dehydrated with ascending grades of ethanol. The antennae were mounted on stubs and then coated with a thin layer of gold (Metallizer Q150R ES, Quoron®).
It was possible to observe that the antennal pedicel is completely covered by scales, however, no sensilla were observed. Nevertheless, the antennal scape was characterized by the presence of numerous sensilla and no scales. The antennal flagellum is constituted by antennomeres of cylindrical format. The dorsal surface of the flagellum is covered by scales, which are absent on the ventral surface, characterized by the presence of sensilla. It was possible to observe the presence of some sensilla emerging among the scales on the antenna dorsal surface. In some samples, in which the scales of the dorsal surface were removed during the antenna assembly, it was possible to observe the presence of many sensilla. Six types of sensilla were identified in the coconut moth antenna: Böhm's bristles, tricoid, baseconic, coeloconic, stiloconic and auricilica. The Böhm's bristles were found at the base of the antennal scape. The other sensilla types were observed in the antennal flagellum. The tricoid sensilla were the most abundant sensilla identified and the auricilica sensilla were only present in the antenna dorsal surface.

P-61 Distribution and ultrastructure of the antennal sensilla of the grape weevil *Naupactus xanthographus* Germar (Coleoptera: Curculionidae)

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The grape weevil, *Naupactus xanthographus* Germar (Coleoptera: Curculionidae), is an insect polyphagous native to southern South America, which causes damage in different economically important species, such as grape, avocado, apple, and other fruit species.
In this work, the morphology and ultrastructure of the antennae and the antennal sensilla of males and females *N. xanthographus* were investigated using scanning electron microscopy (SEM) and transmission electron microscopy (TEM).
The antennae of males and females *N. xanthographus* consists of a straight scape followed by a pedicel and flagellum, with the flagellum composed of the funicle and a distal mass called the club. The flagellum is formed by six funicular antennomers and four fused but distinguishable antennomers of the club; thus, the antenna has a total of twelve segments including the scape and pedicel.
Different types of sensilla were observed, such as sensilla trichoidea, sensilla chaetica type 1 and 2, sensilla basiconica, and sensilla rod-like. Additionally, some cuticular pores were observed on the antennal surface. The type, size, and number of sensilla covering the different segments of the antenna were not different between male and female antennae. The club segments had the highest number of sensilla, followed by decreasing numbers in the order funicle, scape, and pedicel.
Sensilla trichoidea and sensilla chaetica are the most abundant structures on the antennae of *N. xanthographus*. Based on their morphology, sensilla chaetica are mechanoreceptor, while sensilla trichoidea and basiconica are chemoreceptors. For the sensilla rod-like we will make new TEM images to elucidate its function. The cuticular pores may be openings of epicuticular glands, although a role in chemosensory processes has also been suggested.

P-62 Determination of phytotoxic effect of limonene (*R*,*S*) in feeding bioassays against *Hylastinus obscurus* (Coleoptera: Curculionidae)

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Red clover (*Trifolium pratense* L.) is a valuable forage legume in temperate regions of the world and in Chile is an important resource for seed industry and animal production and is used primarily in short-rotation pastures and as hay, silage and soiling. The main factor involved in the low persistence of *T. pratense*is the infestation by the red clover root borer, *Hylastinus obscurus*. This curculionid causes a significant reduction in production levels and persistence of red clover because of both larvae and adults bore and feed into the roots. Studies carried out by the group of Química Ecológica of the University of La Frontera have determined that the terpene limonene present in the roots of clover acts as a repellent against this insect. However, it has not been determined if this terpene will have any toxic effect on the insect. Due to the above, the objective of this research was to determine the phytotoxic effect of limonene (*R*,*S*) on *H. obscurus* in feeding bioassays. For this, the insects were fed an artificial diet composed of cellulose, glucose, starch, agar and distilled water, and evaluated at four different doses of the enantiomers *R* and *S* of limonene (1, 10, 100 and 1000 ppm). As control, the same artificial diet was used without the addition of terpene. The initial and final weight of the insects was recorded to determine the phytotoxic effect of limonene. Preliminary results indicate significant differences between *S* and *R*-limonene ($P \leq 0.05$). The dose of 1000 ppm of *R*-limonene elicited an antifeedant effect on *H. obscurus*. These results suggest that: 1) enantiomer *R* in doses close to 1000 ppm should be toxic to *H. obscurus* and 2) confirm the detrimental effect of limonene on *H. obscurus.*

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P-63 Evaluation of two commercial pheromones for male captureof *Diatraea saccharalis* (Lepidoptera: Crambidae) in sugarcane crops in Colombia

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The aim of this work was to evaluate the effectiveness of two commercial pheromones Isca® and Pheroma® for the attraction of adult males of *D. saccharalis* in 5 months old commercial fields of panela sugarcane (non-centrifugal cane sugar) production, in the semester A of 2017. Two trials were carried out, the first was established in Moniquirá (Boyacá) using a completely randomized design with 3x2 factorial arrangement with 5 repetitions. The two pheromones, the control (virgin females) -Factor 1- and two types of traps, Delta and Gallon -Factor 2- were evaluated. Trial 2 was established in three municipalities: Moniquirá, Chitaraque (Boyacá) and Páramo (Santander), like the previous one, using only the gallon trap. In the two trails, the traps were located 60 cm high, 30 m apart and evaluations were carried out for eight days. ANOVA and Tukey's multiple comparison tests were performed. In trial 1, there were no catches when commercial pheromones were used in any type of trap, for this reason only the trapping methods were compared with the control. Significant differences were found between the traps ($p = 0.0047$), with the highest average male catch in gallon traps 2.65 and 1.05 in the Delta trap. For trial 2, only in Moniquirá catches occurred in the three treatments, had significant statistically differences between the control and pheromones ($p = 0.0001$). The highest average of captures corresponded to the virgin females with 6.6 males; there were no differences among pheromones, with the average capture of 2.6 males for Pheroma® and 0.6 males for Isca®.

P-64 Olfatometric behaviour of *Chrysoperla defreitasi* (Neuroptera: Chrysopidae) to volatiles compounds released by two ecotypes of *Ugni molinae*

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Tri-trophic interactions are characterized by the attraction of predators to attack herbivores due to chemical signal released by damaged plants. These alarm compounds are mainly volatiles that are able to reach predators and attract them to plants. *Ugni molinae* "murtilla" is a shrub native from Chile subjected to a domestication process. In this framework, several ecotypes were collected in different areas and adapted to different environments. Hence, the main question is: Are there a difference in the volatiles profile of two ecotypes of murtilla (19-1 and 22-1) that modified the olfactometric behaviour in the predator *Chysoperla defreitasi* (Neuroptera: Chrysopidae)?. A green lacewing was placed in an olfactometer of 4 arms and deposited in the centre. The stimulus (19-1 and 22- extract) was placed in two opposed arms and hexane was used as control. The behaviour of the predator was observed over 20 minutes. Volatiles compounds were collected during 24 h by enclosing an individual plant into a glass chamber. Then, were absorbed on 100 mg of Porapak-Q columns. Then, volatiles were extracted by elution with 1 mL of hexane. Volatile compounds were analyzed using gas chromatography coupled to a mass spectrophotometry (GC-MS). Separation was performed using a capillary column BP-1 and helium gas as carrier. Our results showed that *C. defreitasi* showed a preference for the Ecotype 19-1 with 70% of the election in contrast to Ecotype 22-1 with 30% of preference. The GC analysis mainly showed that Ecotype 22-1 presented a reduction of 30% in the total content of limonene in comparison to Ecotype 19-1. In conclusion, the preference of *C. defreitasi* to Ecotype 19-1 could be related to the higher content of limonene present in this ecotype in relation to the ecotype 22-1, indicating a possible attractant effect of this monoterpene.

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P-65 Evaluation of meso-dispensers for mating disruption of *Lobesia botrana* (Lepidoptera: Tortricidae) in urban areas of central Chile

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Lobesia botrana (LB), a severe pest of grapes in Europe, was detected in Chile in 2008 and has been, for almost a decade, since then subjected to an Official Control Program by the Chilean Department of Agriculture. LB has also been found on backyard grapes in urban areas, and becoming important refuges for large populations, which can be significant sources of re-infestation to vineyardsbut chemicalsprays are not allowed for intensive pest management in urban areas.In agricultural areas,mating disruption technique (MD) mostly ISONET®-L (recommended at 500 dispensers/ha) has been used as an indispensable tool to controlLB, and greatly succeeded. However, in towns, it is not easy to evenly deploy at 500 dispensers/ha. In order to apply MD technique for LB control in urban areas, a new meso-dispenser (MeD), 10xlarger than regular ISONET®-L and recommended rate at 50 units/ha, which is much easier to deploy, has been developed.The efficacy of the MeD was evaluated in three consecutive seasons (2015-18)in a few towns. The results show remarkable differences of male captures in traps and clusters infestationsbetween treated with the MeD and untreated towns. Number of male captures per flight ranged between 48-1.113 (MeD-MD) and 3.581-28.403 (untreated controls), and significantly declined along with the number of seasons using MD. Disruption index ranged between 68.9 and 98.9 (considering flights individually), and were above 88% when considering the whole seasons. Regarding the presence of eggs, larvae, and pupae infesting clusters, the damage significantly declined with consecutive treatments with MeD-MD. Overall, the results clearly demonstrate a significant reduction of LB in urban areas.

P-66 Geostatistical techniques applied to catch distribution of *Diatraea crambidoides* (Grote) (Lepidoptera: Crambidae) with a sex pheromone trapping in sugar cane crop

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In sugarcane cultivation areas with the CP 72-2086 variety, eight samplings of the adult populations of the shoot borer *Diatraea crambidoides* (Grote) were carried out to determine the population dynamics from 5 to 12 months of age of the crop, and comparisons were made with larval dynamics at the same ages. Using geostatistical methods, spatial distribution maps of captures were obtained using Heliothis traps and using as an attractant sex pheromone of virgin females of *D. crambidoides*. Using geostatistical estimation techniques such as Kriging, were conducted a spatial representation of populations monthly based on adults of *D. crambidoides* captured and with this it was possible to analyse the temporal evolution of the populations. Several semivariograms were used according to the behaviour of the populations in each month, in which, depending on the type of distribution, exponential, circular semivariogram were used, and there is an important nugget effect that denotes the oscillations in the densities of the pests. The behaviour of the populations is of exponential type both in adults and in larvae being able to analyse from the populations of adults. With the information extracted, we have a new proposal for monitoring the pest by this technique, to have information prior to the use of different control methods, such as the release of parasitoids or the application of entomopathogens, and also serves as a basis for new techniques of biocontrol (sexual confusion, massive trapping).

P-67 Role of Cuticular Hydrocarbons in Intra-specific Communication of *Cimex lectularius* (Cimicidae: Hemiptera)

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During the last two decades, the upsurge of bed bugs infestations and repeated failure in chemical control practices were reported worldwide. The research efforts should be addressed to develop innovative control tools. In particular, a new approach based on chemical communication of bed bugs could improve an IMP program. In this study, we evaluated the role played by cuticular hydrocarbons (CHC) of *C. lectularius* to mediate their aggregation/attractantbehavior. We hypothesized that CHC are involved in chemotactic recognition between bed bugs. For assessing the effect of cuticular extracts, groups of adults consisted of 8, 16, 32 and 64 individuals (male or female groups) were isolated for 6 days. Then, cold-euthanized groups were placed into vials and covered with dichloromethane (DCM ranging from 20 µl–4 ml, proportionally with a total mass of insects in each group). After 15 min of extraction, the solvent was evaporated and reconstituted with 40 µl of DCM and used for the stimuli test. The experimental arena consisted of a circle filter paper divided into two zones: the treatment zone was impregnated with cuticular extracts and solvent only in the control zone. First-stage nymph and virgin adult (male/female) were released individually and its activity was recorded for 15 minutes using a video-tracking equipment. The measurement of variables that included distance, velocity, and mobility was quantified with EthoVision XT 10.1 software. Results showed a dose-response effect to different extract groups. Whilst a positive preference was observed toward 16 and 32 groups, extracts in upper dose generated avoidance behavior. In all cases, there were no differences between the sexes. Currently, we are performing identification and quantification of chemicals compounds by GC-MS analysis to elucidate the specific CHC involved and evaluate the effectiveness of candidate blend for its usage in bed bug monitoring strategies.

P-68 Exposure to the essential oil of *Schinus polygama* increases the sexual signalling of *Ceratitis capitata* sterilemales

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Volatile exposure of phytochemicals has been shown to increase male sexual competitiveness in some fruit flies. Such improvement might be associated with an increment in sexual signalling. In previous studies, we observed that mating success of *Ceratitis capitata* males exposed to the essential oil (EO) of *Schinus polygama* (Anacardiaceae) is equal or even greater than the achieved by males exposed to ginger root oil (GRO), an essential oil used in some mass rearing facilities of *Ceratitis capitata* that implement the Sterile Insect Technique (SIT). In the present study, we evaluated the effort in sexual signalling performed by sterile males exposed massively to GRO or to the EO of *S. polygama*. *C. capitata* males from the strain *tsl* Vienna 7 were placed inside plastic boxes (60 cm x 40 cm x 32 cm) to hold mature pupae and newly emerged adults before its release for a SIT program (24,000 flies per box arranged in 4 paper bags holding 6000 flies each one). One day prior to adults release, 400 mL of GRO or *S. polygama* EO were applied in paper filter disks (10 cm diam.) at the bottom of a Petri plate over the floor of the plastic box. After the exposure, 5 males were placed inside one glass jar (180 mL capacity) covered with voile. Each treatment was evaluated in 10 replicates and the experiment was repeated three times (days) with independent batch of flies. Exposures were carried out in independent rooms at 16:8 h light-darkness at 20 ºC. The control treatment without EO volatile exposure ran simultaneously in a plastic box without exposure. The number of males performing some of the following behaviours was recorded: wing funning (F), anal pouch exposure (AE) and F+AE. Data were registered at intervals of 15 min from 9:00 to 10:00 AM. Results showed that AE behaviour was increased in males exposed to *S. polygama* EO ($p=0.004$). Unexposed males displayed the least frequency of AE behaviour and, GRO treatment exerted an intermediate increase in the frequency of this behaviour. Therefore, it is likely that the improvement in mating success of males exposed to *S. polygama* EO is explained by the fact that females respond to the calling of males exhibiting a greater effort in sexual signalling.

P-69 A male-specific compound produced by the vanilla weevil Montella sp. (Coleoptera: Curculionidae)

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The orchid of the species Vanilla planifolia, known as vanilla, suffers constant attacks by the curculionid-beetle Montella sp. (COLEOPTERA: CURCULIONIDAE: BARIDINAE), incident on commercial crops in the southern region of Bahia State, Brazil. The larval stage opens galleries which prevent sap flow in the plant stems and the adults scrape the flower petals, reducing the commercial production of vanilla. In this way, this work aims to identify the aggregation pheromone for controlling this weevil in vanilla crops. Adult were collected in vanilla fields and kept in laboratory boxes. Males and females were separated through differences in the abdominal region, and their volatiles were collected by dynamic headspace technique. The volatiles extracts were analyzed by gas chromatograph coupled to mass spectrometry (GC-MS) and the chromatograms showed a male-specific compound. Preliminary MS analyzes suggested this compound as an unsaturated long-chain acetate. Although the proposed structure is unusual for curculionids, this is the first study of Baridinae pheromones. The full identification and synthesis of this compound are underway, besides olfactometry tests to verify the bioactivity of the natural compound.

Keywords: Vanilla. Semiochemicals. MIP.

P-70 Sampling plan for the *Rynchophorus palmarum* with pheromone traps in oil palm

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Populations of the palm weevil *Rynchophorus palmarum* can be monitored using traps with pheromones. Within a sampling plan for this pest it is important to know the number of traps to be used to estimate weevil populations. The objective of this research was to determine the density of traps required per hectare within a conventional sampling plan. There were 12 consecutive samplings every 8 days in an oil palm crop in an area of 70 ha., the traps separated with a distance of 100 m and they were baited with molasses and sugar cane fermented plus rhyncolure of ChemTica. All the data of the captures of each sampling were adjusted to a negative binomial distribution. According to Taylor's power law, the distribution of the pest was aggregated with a coefficient of 1.75. Based on the parameters estimated by the Taylor Power Law, it is suggested that the optimum number of traps to be used is 8 in an area of 70 ha. with an accuracy of 80%. Therefore, under these conditions one trap can be used to monitor the pest present in 9 ha.

P-71 Attractiveness of a blend of pheromones of *Pseudococcus calceolariae, Pseudococcus longispinus* and *Pseudococcus viburni* (Hemiptera: Pseudococcidae) to adult males of these species in laboratory conditions

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Pseudococcus calceolariae, Pseudococcus longispinus and *Pseudococcus viburni* are three species of mealybugs (Hemiptera: Pseudococcidae) present in Chile with economically importance for agriculture. As the pheromones of these species are structurally different, the possibility of using them in combination can be interesting as a control tool. The attractiveness of adult males of *P. calceolariae, P. longispinus* and *P. viburni* to individual pheromone was measured as well as a blend of all three pheromones in laboratory conditions. Males between 0 and 3 days of age were used. For the intra-specific attraction, doses of 1, 3 and 5 ng of pheromone were evaluated contrasting with hexane (solvent). The combination of all three pheromones was prepared was with 3 ng (*P. calceolariae*), 5 ng (*P. longispinus*) and 5 ng (*P. viburni*) doses. Both, each pheromones and combination of pheromones, was evaluated in petri dishes with four replicates per treatment and 10 adult males per replicates (n=40). In each species, adult males were attracted to sex pheromone in all of three doses proved. The attractiveness of blend of pheromones in *P. calceolariae* was 50%, higher than individual pheromones (F=23,87; p= 0,003). Whereas, the attraction of *P. longispinus* (50%)and *P. viburni* (12,5%), was not significantly different to individual pheromone (F=2,44; p=0,169 and F=0,20; p=0,672, respectively). Repellency was not observed in any of the species. This result indicated that would be possible to use a mix of pheromones to control more than one of mealybug species at the same time.

P-72 Evaluation of the secondary metabolites produced in co-culture by the endophytic microorganisms *Phyllosticta* sp. and *Bacillus* sp. from *Podocarpus macrophyllus*

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In nature, interactions between bacteria and fungi are present in complex communities like plants. These interactions are mainly based on the production of some secondary metabolites, which may sign defence mechanisms due to competition for limited resources. These interactions may follow different mechanisms and despite of the difficult to determine precisely how it works, the observation of the inhibited microorganism development can provide good insights. Therefore, simulating the natural environment through co-culture is a promising strategy to induce the production of novel metabolites. The presence of interacting species can modulate the biosynthetic behaviour of these metabolites possibly through gene activation, in addition, the toxicity of these new molecules is dependent on the target species. This study aims to co-culture the endophytic fungi *Phyllosticta* sp. with the endophytic bacterium *Bacillus* sp., both isolated from *Podocarpus macrophyllus*, in the PDA and R2A medium. These microorganisms are dominant in the host plant, being isolated throughout all the seasons of the year and from all the organs of the plant. Thus, co-culture experiments were performed in Petri plates to investigate which metabolites derived from the bacterium *Bacillus* sp influence the growth of the fungi *Phyllosticta* sp during their interaction. The radial growth of the fungi was monitored throughout 14 days of incubation and the area occupied by their growth was determined. The borders of the colonies, developed in the dual-cultivation in Petri plates, were extracted using a micro extraction procedure and analysed by MALDI-TOF MS and LC-MS to evaluate the change in the chemical profile. The spectra acquired showed two homologous series of ions detected at *m/z* 1000-1100 and *m/z* 1450-1560 in the microextracts obtained from the *B. subtilis* control, and from three samples extracted from the *Bacilus-Phylloticta* contact zone in the experiment, being one from the area close to the bacteria, one close to the fungus, and one from the intermediary position between both microorganisms. The ions in the cluster detected at *m/z* 1000-1100 were characterized as surfactins and iturins, and those detected at *m/z* 1450-1560 may correspond to fengycins. The presence of these compounds in all the microextracts collected in different regions of the co-culture plate corroborates with the mechanism of diffusion of these metabolites through culture medium, which explains the anti-symmetrical growth of the fungus colonies.

P-73 Diversity and antimicrobial activity of bacterial symbionts of *Cecropia-Azteca* interaction

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Natural products play an important role in the discovery of new active compounds. Many of these organic compounds are secondary metabolites produced by microorganisms and their biological activity originates from interactions between microbes and the environment in which they are inserted. The association among organisms of different species is a phenomenon that can be found widely in nature. One example is the symbiosis between microbes and leaf-cutter ants, where the microorganism and their metaboliteshave nutritional and protective importance for the ants. Another example of interaction is the symbiosis between ants of the genus *Azteca* andmyrmecophytes of the genus *Cecropia*. In this system, the plants provide food and housing to the ants, and the ants provide protection to the plant. Although this interaction has been described in the literature for years, the role of microbiota in this interaction is still understudied and no chemical ecology studies have been described. In effort to understand the microbial diversity associated with *Cecropia-Azteca* interaction, 09 different collections of ant-plant system were carried out in Atlantic Forest and Amazon. The 35 isolated bacteria were identified by 16S rRNA sequencing and challenged against different entomopathogens and human pathogens in order to correlate the biological activity with their ecological function. The bioassay results showed that five *Streptomyces* sp. and four *Pseudomonas sp.* strains were the most effective in inhibiting a higher percentage of pathogens. By using LC-MS/MS and NMR we have identified that *Streptomyces* spp. produce amphotericin while *Pseudomonas* sp. biosynthesizes the cyclic lipopetide pseudosdemin A as the bioactive compounds. Finally, the participation of these strains in nitrogen fixation in the ant-plant interaction was also investigated, and the experiments showed that the *Pseudomonas* spp. are able to fix nitrogen. Therefore, bacterial symbionts of *Cecropia-Azteca* myrmecophytic interaction can produce antimicrobial compounds against entomopathogens and also help in nitrogen fixing.

P-74 Repellent activity of extracts isolated from *Cestrum parqui* Hérilt against *Hylurgus ligniperda* (Coleoptera: Curculionidae)

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Hylurgus ligniperda (Coleoptera: Curculionidae) is one of most important quarantine forest insects associated to radiata pine logs export in Chile. In recent years, this insect has caused important damages on 1 or 2-year-old seedlings trees causing death by root collar. This type of damage has only been observed in conifer forest in Chile. Chemical treatments have not been successful to control this plague. Hence, research to find alternative treatments for controlling this pest are urgently needed for the Chilean forestry sector. The Chemical Ecology Group of the Universidad de La Frontera has been studying novel strategies for controlling several economical pest. Among them, natural compounds such as semiochemicals and phytochemicals are being investigated. In this context, secondary metabolites from *C. parqui* possesses bioactive compounds eliciting important detrimental effects on survival, growth and reproduction of a broad range of plague insects belonging to Lepidoptera, Hemiptera, and Coleoptera orders. In the present study, repellents activity of ethyl acetate extract obtained from *C. parqui* leaf were evaluated on male and female of *H. ligniperda*. The results showed that ethyl acetate extract exhibited a significant repellent effect against male of *H. ligniperda* at low doses.

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P-75 Olfactometric tests for the determination of repellency action against *Spodoptera frugiperda* (Lepidoptera: Noctuidae) by leaves and macerated of *Azadirachta indica* (Neem)

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Secondary metabolites can be used plants to defend themselves against the attacks of insects. Among these active metabolites, volatile organic compounds (VOCs) are usually found in the essential oils of plants and belong to the family of terpenes. An alternative to the use of synthetic insecticides is the use of aqueous extracts and oils derived from the *Azadirachta indica* tree (Neem). Neem has been widely used in pest control, since it has several properties such as growth antifeedant, repellent, antiovipositor and sexual communication switch. The active agent is azadirachtin, which has been proven to behave as a natural insecticide; hence, it could be the precursor of a new generation of natural insecticide products. This work provides information on the behavioral responses of fall armyworm *Spodoptera frugiperda* to the VOCs released by neem fresh leaves in laboratory bioassays. Olfactometry tests were carried out to evaluate the preference of the insect when it was offered the stimulus from two different samples. These tests were carried out with adult females *of S. frugiperda* and a Y-type olfactometer. A stream of air filtered through activated carbon was supplied to each arm of the olfactometer using an aeration pump. The tests were performed by placing the insect (one at a time and without repeating) against the stimulus from the olfactometer containing the sample and the control corresponding to the absence of test material. Three double-choice bioassays of 30 repetitions each were performed:
I) Healthy leaves of Neem vs. control.
II) Crushed leaves of Neem vs. control.
III) Macerated Neem vs control.
Series I and III presented significant differences of choice ($p < 0.05$) being the preference to Neem leaves o macerates lower than that of control. VOC of the healthy Neem leaves and their maceration showed a repellent effect against fall armyworm.

P-76 Use of steered molecular dynamics to evaluate binding selectivity of a pheromone-binding protein from *Lobesia botrana*

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The grapevine moth, *Lobesia botrana*, is a major pest for vineyards and other berries in Chile; larvae from *L. botrana* feeds on grapes, reducing production yields and increasing fungal infection susceptibility. *L. botrana* population control implemented by SAG is based on periodic monitoring and use of sexual confusion techniques, last one focus on synthetic pheromone release to disorient male moths and disrupt mating, but does not work if population is too high. Information about how diverse volatile interact with *L. botrana* olfactory system is required to maximize control techniques efficiency. At a molecular level, odorant-binding proteins (OBPs) located in insect antennae have been identified as responsible for hydrophobic molecule transport through sensillar lymph to receptors capable of unleashing a neuronal response. The OBPs are soluble extracellular proteins conformed by six α-helices and three disulfide bridges who act as filters to selectively recognize, bind and transport certain classes of volatiles. Pheromone-binding proteins (PBPs) are a subgroup of OBPs that is believed to transport pheromone related compounds only. Considering the above, the objective of this study was to evaluate the binding selectivity of a PBP (LbotPBP1) with male-biased expression against eleven sex pheromone components and six host plant volatiles. An homology model of LbotPBP1, molecular docking and 20 ns of complex molecular dynamics were performed to achieve a protein-ligand final state, from here, steered molecular dynamics, as a disruption of protein-ligand binding through a force of pulling at constant velocity, were carried out. Our results showed that the accumulative force required to extract pheromone compounds was higher than plant volatiles. Likewise, diverse specific interactions were identified on pheromone-type ligands but did not appear when host plant volatiles where pulled, showing preference for sex pheromone components over host plant compounds.

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P-77 Morphological and functional characterization of sensilla on the antennae of *Lobesia botrana* (Denis & Schiffermüller) (Lepidoptera: Tortricidae)

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The olfactory system of insects has functional elements called sensilla that are involved in their behaviour. Also, proteins are found inside these structures, which are related to the recognition of volatile compounds. We investigated the morphology and distribution of sensilla in the antennae of *Lobesia botrana* using Light Microscopy, Scanning and Transmission Electron Microscopy. In addition, expression of the gene encoding for Pheromone Binding Protein (LbotPBP1) was studied by in situ hybridization for functional characterization. The results revealed that *L. botrana* has filiform antennae; they are subdivided into three usual parts: scape, pedicel and flagellum. The total length of flagellum was significantly greater in males (3.03 mm) than in females (2.47 mm). Six morphological types of sensilla (trichoidea, chaetica, coeloconica, auricillica, basiconica, styloconica) were identified on the antennae of both sexes. Trichoidea sensilla were the most abundant on the antennae of *L. botrana*, and their length was greater in males than in females. Moreover, LbotPBP1 expression was restricted to this type of sensilla confirming its olfactory role, specifically in the sexual pheromone perception.

P-78 Attacked Citrus Plants Release Synomones that Attract an Egg Parasitoid, *Cosmocomoidea annulicornis* (Hymenoptera: Mymaridae)

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It is known that hymenopteran parasitoids generally use a combination of host kairomones and plant induced synomones to locate their hosts. *Cosmocomoidea annulicornis* (Hymenoptera: Mymaridae) is an egg parasitoid frequently found attacking eggs masses of *Tapajosa rubromarginata* (Hemiptera: Cicadellidae), a xylem-feeding sharpshooter vector of *Xylella fastidiosa*, the bacteria that causes Variegated Citrus Chlorosis. In the present study, we evaluated the volatile attraction capacity of citrus plants induced solely by feeding damage of *T. rubromarginata*, without egg masses, to investigate whether plant volatiles alone could act as cues for host finding. Newly emerged *G. annulicornis* (< 12 h), naïve females were used for behavioral assays with Y tube olfactometer dual choice tests (n=40). For the induced treatment, Citrus plants (2 years plants, *Citrus aurantium* var. 75AB, a variety used for grafting lemon trees) were kept in voile fabric bags along with 15 males of *T. rubromarginata* (to avoid oviposition of females) for 24 h before measurements. Non-induced treatment consisted of healthy citrus plants. Females were offered: (a) Air (control) versus Non-induced plants and (b) Non-induced plants versus Induced plants. Wasps had no preferences between the choices offered in the first experiment (a) ($p>0.05$), however, when wasps were offered Non-induced plants versus Induced plants, 67.5% parasitoids chose plants attacked by *T. rubromarginata.* Plant volatiles were isolated and analyzed according to the procedure described by Braccini et al (2015). Non-induced plants produced almost exclusively limonene, whereas induced plants produced a more complex monoterpene mixture.
Based on these results, *T. rubromarginata* feeding damage induces plant synomones, that would be important in *C. annulicornis* host searching behavior.

Braccini, C. L., Vega, A. S., Coll Aráoz, M.V., Teal P. E., Cerrillo, T., Zavala, J. A. & Fernández, P.C. (2015). *J chemecol*, *41*(11), 985-996.

P-79 Floral attractants for *Aedes aegypti* and their incorporation in solid slow release formulations

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The *Aedes aegypti* mosquito inhabits almost exclusively urban areas. The female's marked preferences for human blood-feeding turns her into an efficient vector of mosquito borne diseases, such as: Dengue Fever, Yellow Fever, Chikungunya and Zika. This research focuses on the effects of plant volatile compounds on adult mosquito behavior, with the aim of gaining insights that could be applied in an integrated management of mosquitoes, with a low environmental impact.
An initial screening was performed to assess the adult mosquito's preference to plants commonly present in the domestic environment. Further assayswere performed in an olfactometer, to determine if olfactory cues were also involved in the mosquitoes' attraction towards the plants.
Flower cuttings were tested as bait in a toxic end-point bioassay, which included a pesticide. An increased mortality was observed in females with the cuttings of the following plants: *L. maritima* and *E. pectinatus*; and in males a higher mortality was observed with *L. maritima*, *E. pectinatus* and *S. madagascariensis*.
The compositions of the volatile compounds of the plants with flowers that proved attractant in the olfactometer were also tested in the olfactometer. The volatile compounds that were attractant to females were: (+)-α-pinene and acetophenone; and only 1-nonene was attractant to males.
Disks made from stearin or paraffin, with different amounts of 1-nonene or acetophenone, were formulated. They were also tested as baits, with a pesticide, in a toxic end-point bioassay. The disks made from both materials, with 1-nonene or acetophenone, proved to be attractant to mosquitoes of both genders.
The results that were obtained through this research, suggest that it is possible to use plant volatile compounds and plant cuttings as mosquito attractants which could potentially be included as baits in mosquito traps.

P-80 Preliminary evaluation of semiochemicals produced by kale caterpillar - *Ascia monuste orseis* (Godart, 1819) (Lepidoptera: Pieridae)

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Kale caterpillar, *Ascia monuste orseis* (Lepidoptera: Pieridae), is considered a key plague for the botanical family Brassicaceae, like the kale (*Brassica oleracea* var. *Acephala*). Among the control methods to manage the population of this species, behavioral control has emerged as an alternative method for Integrated Pest Management (IPM). Thus, the present work aimed to identify preliminary differences in the production of volatile compounds emitted by males and females of *A. monuste*. The compounds were obtained by aeration for 24 hours of adult insects aged 24-48h. These extracts were analyzed by GC-FID and CG-MS. Chromatograms of males and females presented differences between them. All compounds present in the female were also found in the male. However, some have proved to be unique to the male. This is an expected fact, since the production of sex pheromones by males of different species of this family has already been reported in the literature. From the fragmentation profile of the mass spectra it was possible to report the presence of terpenes. This class of compounds is quite common acting as a sexual pheromone in species such as *Pieris melete*, *Pieris napi* and *Anthocharis scolymusda*, all belonging to the Pieridae family and the Pierinae subfamily, the same as *A. monuste*. These preliminary results infer structural similarity between the compounds produced by species of the same subfamily and aims to contribute to the later development of efficient products for the control of *A. monuste* and, consequently, to reduce the use of insecticides in IPM.

P-81 Selection of Superqueli-INIA (*Trifolium pratense* L.) genotypes with high formononetin content and their effect on *Hylastinus obscurus* feeding behaviour

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The persistence of red clover (*Trifolium pratense* L.), an important forages legume widely used as a food resource mainly for ruminants, is seriously affected due to *Hylastinus obscurus* which causing a huge damage to the radical system. There is not a chemical control for this pest. The study of the chemical ecology of the plant-insect interaction have shown that the isoflavonoid formononetin elicit a strong antifeedant behavior from *H. obscurus.* Hence, a breeding program with the aim of obtaining genotypes with higher formononetin content emerge as new strategy for controlling to *H. obscurus*. Previous results have shown that formononetin heritability was significant for shoots and roots of Superqueli-INIA. Red clover individual plants with high (HFR) and low (LFR) formononetin content in roots were selected. The intensity of selection was 12.5 %. These selections were cloned and transplanted to isolated pollination boxes for seed production during the season 2016-17 and 2017-18. Pollination was managed with *Bombus terrestris* and *B. ruderatus*. Progenies were grown during the season 2017 in the greenhouse and plants were sampled individually from each progeny to evaluate formononetin content. The content of radical formononetin of 116 new genotypes were analyzed by HPLC. 20 mg were extracted with methanol 100% and sonicated 15 min and centrifuged at 3000 rpm (15 min at 21 °C). 30 µL of the supernatant was diluted up to 1.5 mL with methanol (100%). 25 µL was submitted to HPLC analysis. The results showed that the genotypes selected by HFR and LHR kept this category in the progenies. A feeding bioassay was developed on *H. obscurus* for testing the antifeedant activity of the material with the highest (1.3 mg/g DW) and the lowest (0.02 mg/g DW) amount of formononetin. The results showed that the HFR material elicited a significant decreasing of the weigh in adults of *H. obscurus*.

P-82 Defense mechanisms in *Aristolochia chilensis* (Aristolochiaceae) upon specialist herbivore attack

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Plants have developed different defense strategies to deal with herbivore attack. Whereas direct defense is conferred by chemical and physical traits that can repel enemies, indirect defense includes the emission of volatile organic compounds (VOCs) that attract carnivorous organisms, the third trophic level. *Aristolochia chilensis* is a herbaceous perennial plant native to Chile that contain toxic aristolochic acids (AA) in its tissues. Larvae of the butterfly *Battus polydamas archidamas* can sequester AAs, feeding only on *A. chilensis* leaves. Under field conditions, we explored direct and indirect defense responses of plants of *A. chilensis* when attacked by the specialist herbivore *B. polydamas archidamas.* For this, plants of *A. chilensis* of similar size were randomly selected and excluded from natural herbivores. Plants were subjected to damage by larvae of *B. polydamas archidamas* for 24 hours. Untreated and mechanically wounded plants served as reference. As direct chemical and physical defenses we measured AA content, number of trichomes, leaf toughness and SLA (specific leaf area) in all plant groups. As indirect defense, VOCs were collected during 24 hours in all plants. The attraction of carnivore ants after volatile emission was also evaluated. Herbivore damage did not induce the content of AAs in plants of *A. chilensis*. From morphological traits, leaf toughness was the only trait that significantly increased in response to specialist herbivore damage over time. Additionally, a subset of VOCs was specifically induced by the specialist herbivore. However, this observation was not associated with the attraction of the third trophic level. Larval feeding was able to elicit direct and indirect defensive responses in *A. chilensis*, suggesting potential resistance mechanisms in response to specialist herbivore yet to be determined.

P-83 Antarctic fungi: A natural source of fungal genetic diversity and biological activities

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The search for natural antimicrobial compounds has become a focal point of interest for natural product chemistry. At this respect, microorganisms from extreme ecosystems, such as the Antarctic, need to survive in harsh conditions with low temperatures, low nutrients and high UV radiation. All this makes these microorganisms a rich source of bioactive compounds. Therefore, the objectives of this study were to identify genetic diversity, through molecular identification by region sequence (ITS1 and ITS4), plus MALDI TOF/TOF mass spectrometry, to evaluate the antifungal activity of volatile organic compounds (VOCs) of isolated fungi from Antarctica against *Botrytis cinerea*, and the antibacterial activity against *Escherichia coli*, *Straphylococcus aureus* and *Listeria* sp. In addition, the growth curves at different temperatures (10, 15, 20 °C) were constructed. A preliminary set of strains (7) isolated from Antarctic soil were evaluated. The results showed that at 20 °C the growth in PDA medium was higher for all the strains of Antarctic fungi. Whereas, in the evaluation of antifungal activity by VOCs was weak, the best results were observed in the strains M1-07 and M1-02, showing inhibition growth of *B. cinerea* less than 10%. Surprisingly, ethyl acetate extract obtained from the same strains of Antarctic fungi showed antibacterial activity. M1-07 at a dose of 500 µg elicited an inhibition of approximately 35% of *Listeria* sp., and M1-02 with a dose of 250 µg resulted in an inhibition of 40% of the same bacteria. Molecular identification showed that M1-07 R2 and M1-02 R1 corresponded to *Cosmospora* sp. and *Clonostachys* sp. respectively. In summary, this study indicated the potential use of the active secondary metabolites as novel antibacterial compounds. Currently, we continue the study of the secondary metabolites responsible of the antibacterial activity as well as the screening for antimicrobial effect of 25 more isolated Antarctic fungi strains.

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P-84 Interaction between *Drosophila suzukii* and yeasts: Volatile signals of *Hanseniaspora uvarum* mediate attraction in flies

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Droshophilids and yeasts have evolved mutualistic associations that facilitate their development and survival, and are fundamental for the occupation of their niches.
Volatile organic compounds (VOCs) derived from yeasts that are detected and discriminated by the olfactory system of fruit flies play an important role for establishing the interaction between yeast and flies.
Drosophila suzukii (Diptera: Drosophilidae), is an insect pest on soft-skinned fruit that during the last decade invaded many countries in Europe and the Americas. We previously showed that *D. suzukii* is strongly attracted to the yeast *Hanseniaspora uvarum*, a predominant yeast of the early fermentation phase in fruits and associate of adult and larval flies. Here, we examined specific *H. uvarum* VOCs for *D. suzukii* attraction. We performed headspace collection of *H. uvarum* cultivated in minimal medium and, combined with GC-EAD technique, we identify electrophysiological active compounds as basis for behavioral experiments. Larval tracking bioassays show that larvae are attracted to single components of *H. uvarum* headspace. Our results suggest that the interaction of *D. suzukii* with *H. uvarum* is primarily mediated by VOCs. Understanding the chemical communication underlying yeast-insect associations might facilitate the development of tools to disrupt host-insect interactions in pest insects such as *D. suzukii*.

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