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OBCL Newsletter

Overseas Biological Control Laboratories
US Department of Agriculture, Agricultural Research Service

Edited by Dawn Gundersen-Rindal

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Introduction

OBCL is a group of overseas laboratories that support the domestic research carried out by USDA-ARS with the aim of "finding solutions to agricultural problems that affect Americans every day from field to table".

The **Australian Biological Control Laboratory (ABCL)** is based in Brisbane, Australia. The facility is run through a Specific Cooperative Agreement between USDA-ARS and Australia's Federal research body, CSIRO.
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The **European Biological Control Laboratory (EBCL)** is based in Montpellier, France, and has a satellite laboratory in Thessaloniki, Greece. Contact: Dawn Gundersen-Rindal, dawn.gundersen-rindal@ars.usda.gov / www.ars-ebcl.org

The **Foundation for the Study of Invasive Species (FuEDEI)** is based in Hurlingham, Argentina and is operated as a nonprofit research organization. Contact: Guillermo Cabrera Walsh, gcabrera@fuedei.org / www.fuedei.org

The **Sino-American Biological Control Laboratory (Sino-ABCL)** is based in Beijing, China.
Contact: Liu Chenxi, liuchenxi@caas.cn

Previous newsletter editions are available at:
www.ars-ebcl.org

European Biological Control Laboratory - EBCL

100th Anniversary Celebration for the USDA ARS European Biological Control Laboratory

by Dawn Gundersen-Rindal

During the first week of April, 2019, the European Biological Control Laboratory (EBCL) celebrated its 100th anniversary with centennial events held in Thessaloniki, Greece and Montpellier, France. EBCL was established originally to discover biological control agents for the European corn borer, an invasive pest of great economic importance as it caused damage to corn and other crops in the United States.

Figure 1. The European Biological Control Laboratory main research building in Montferrier-sur-Lez, France.

The present EBCL is still true to the core of its original research mission, which is to find in their native range, describe, and evaluate the natural enemies of invasive insect and weed pests that cause problems in the United States. However, today's EBCL researches and solves problems associated with many more invasives, including agricultural

insect pests, weeds, and biting arthropods. A few examples of invasive pest research targets include agricultural insects - Brown marmorated stinkbug, Bagrada bug, and Olive fruit fly; weeds - French broom, Ventenata, Medusa head and Giant Reed; and biting arthropods - Phlebotemus sandfly and Cattle fever tick.

The EBCL was first located in Auch, France, in 1919, to find natural enemies of invasive insects originating in Europe, Eurasia and Africa. In 1959, the EBCL added the mission of biological control of invasive weeds. The EBCL moved several times over the century and was most recently located in a suburb of Montpellier, in southern France, where the current laboratory and quarantine facility was opened in 1999 (Figure 1). This is a 19,375-square foot facility located on a 4.9 acre plot on the Campus International de Baillarguet, part of Agropolis International, the large European center for agricultural research and training. The EBCL also has an important satellite laboratory in Thessaloniki, Greece, co-located with the American Farm School (AFS) (https://www.afs.edu.gr/) which focuses on control of biting arthropod insect vectors of human and animal diseases and on control of invasive weeds.

EBCL was privileged to be visited by our ARS Administrator, Dr. Chavonda Jacobs-Young, Associate Administrator, Dr. Steven Kappes, and Director of the ARS Office of International Programs, Mr. Bryan Norrington, as well as other honored guests, in celebration of the EBCL 100th anniversary. The ARS leadership team visited EBCL facilities in Thessaloniki, Greece, and those of AFS, and met with AFS president, Dr. Panagiotis Kanellis, to discuss ARS collaborative research and mentoring (Figure 2). In Montpellier, France, they participated in a formal celebration of the EBCL centennial held at Agropolis International, with over 100 guests attending, including research colleagues from international research entities and partners, Universities, and current and former members and directors of EBCL (Figure 3). Mr. Simon Hankinson, Consul General (Marseille, France), gave opening comments about the importance of EBCL in France. Drs. Jacobs-Young and Kappes spoke about the ARS mission and the ARS biological control research accomplished overseas, respectively. A highlight of the centennial program for many was a presentation on the history of 100 years of EBCL- a trip down memory lane for former members of the lab- delivered by EBCL scientist Dr. René Sforza. The morning program was followed by a reception. In the afternoon, an Open House was held at the EBCL facility, where colleagues and collaborators gathered to hear about current EBCL research.

Figure 2. ARS Administrator, Dr. Chavonda Jacobs-Young, Associate Administrator, Dr. Steven Kappes, Office of International Programs Director, Bryan Norrington, and members of EBCL meet with president of the American Farm School (Thessaloniki, Greece), Dr. Panagiotis Kanellis, and IMBB colleague John Vontas.

After 100 years, EBCL remains tremendously important to US agriculture and provides a research base for many biological control, integrated pest management, and arthropod disease vector projects. With the rise in global commerce and travel, the risk of invasive species entering the United States from abroad- and vice versa- has increased and is greater than ever. EBCL expects to continue and expand its important mission for many centuries to come!

Figure 3. ARS Administrators Dr. Chavonda Jacobs-Young and Dr. Steven Kappes, and OIRP Director Bryan Norrington, surrounded by current and former members of the European Biological Control Laboratory at the 100th Anniversary of EBCL Celebration, held at Agropolis International in Montferrier-sur-Lez, France on April 5th, 2019.

Evaluation of *Gryon gonikopalense* (Hym.: Scelionidae), as potential biological control agent of *Bagrada hilaris*

by Guillaume Martel & René FH Sforza

Since 2015, EBCL has studied the life history traits of a potential egg parasitoid of *Bagrada hilaris*, an invasive pest of Brassicaceae crops, which first appeared in California in 2008 and has expanded to several southern U.S. states and South America. To answer the demands of growers for sustainable management methods, a biological control program was started. The egg parasitoid *Gryon gonikopalense* Sharma (Figure 4) was collected in Pakistan through a collaboration with CABI (Commonwealth Institute of Biocontrol, Switzerland), and, after morphological identification here described, is being evaluated as a candidate for classical biological control. Basic life history studies were performed in climatic chambers (22 ± 0.5 °C, RH 50 ± 5%, L/D 12:12). On average, *Gryon gonikopalense* developed in 25.1 ± 1.4 (mean ± sd) days and lived 66.4 ± 30.7 days. Allowing females to oviposit reduced their lifespan by 52%, and food deprivation reduced it by 87%. During their life, females produced 59.2 ± 22.3 offspring on average, with maximum fecundity during the first week of life. The mean progeny sex ratio was 46.3% female. Live host eggs from 1 to 4 days old were suitable for parasitoid oviposition, but eggs stored at −80 °C were not. Hence, the parasitoid could attack bagrada eggs for most of their development in the field but storage of bagrada eggs at very low temperature for later use in rearing or as sentinel eggs in the field is not recommended. These data provide a baseline for designing host specificity tests to help determine whether *G. gonikopalense* is suitable for use as a biocontrol agent of *B. hilaris*. The current project is being accomplished in association with the ARS Invasive Species and Pollinator Health Laboratory, Albany, CA, especially studies on the specific oviposition behavior of *B. hilaris* and the ability of *G. gonikopalense* to find and successfully parasitize buried host eggs. This work has been published and may be downloaded at the following link: https://www.sciencedirect.com/science/article/pii/S1049964419300088?dgcid=author

Figure 4. Wild *Gryon gonikopalense* (Hym.: Scelionidae), female collected in Pakistan and currently reared in EBCL quarantine. Photo E. Talamas

An open field test in France: Asclepiads versus a leaf beetle

by René FH Sforza

Swallow-worts, *Vincetoxicum rossicum* (L.) Moench and *Vincetoxicum nigrum* (Kleopow) Barbar (Apocynaceae) present in North America (NA) for over a century, have started to spread only recently. This slow establishment phase followed by exponential growth may be due to density-dependent responses, and such high plasticity may explain why this group has successfully invaded a variety of disturbed and undisturbed habitats in North America. *Vincetoxicum rossicum* tends to be shade-tolerant, and is found further into forest understories, while *V. nigrum* tends to be limited to habitat edge and open areas.

A biological control program started in the late 2000's both at EBCL and CABI Europe for the benefit of the U.S. and Canada. Several candidates were studies, and two have already been released by CABI and Agriculture Canada scientists in Canada. So far, swallow-worts require additional control, and a third insect species is currently studied for a future petition to release after the completion of additional host specificity testing. *Chrysochus asclepiadeus* (Col. Chrysomelidae), is native to Europe and naturally completes its life cycle on a native pan-European asclepiad, *Vincetoxicum hirundinaria,* in western Europe, and on various *Vincetoxicum* spp. in eastern Europe. The purpose of the 2019 open field experiment is to test the host choice preferendum of the beetle over a limited range of plants. A critical point at the moment is to understand whether or not *C. asclepiadeus* is able to feed and reproduce on milkweeds, like *Asclepias syriaca*, the Monarch butterfly host plant. To test the herbivory, a multi-partite collaboration is in place among ARS labs

(EBCL, Ithaca), Michigan State Uni., Ag. Canada, and University of Toronto. Plants to be tested include *V. hirundinaria, V. rossicum, V. nigrum*, and *As. Syriaca*. Apart from *V. rossicum*, imported from the U.S., all other selected plant species will be collected in France. Luckily, *As. Syricaca* is naturalized in some remote stations along the Rhone valley, France.

Figure 5. Wild couple of *Chrysochus asclepiadeus* in Jura, France

Figure 6. *Vincetoxicum hirundinaria*, with white flowers in France

Figure 7. Wild population of *Asclepias syriaca* in the Rhône valley, France

Allium leaf miner: a new target for classical biological control at EBCL

by Gaylord Desurmont

The allium leafminer, *Phytomyza gymnostoma* (Diptera: Agromyzidae), (Figure 8) is an emerging invasive pest in the Eastern U.S. The native range of this species encompasses most of Europe, where it has been documented from Spain to Denmark and from the United Kingdom to Ukraine. It is also present in Asia with record numbers in Turkey and Turkmenistan. It was first detected in the Western hemisphere in 2015 in Pennsylvania and has been since recorded in New York state, Maryland, and New Jersey. The allium leaf miner attacks a wide range of species belonging to the *Allium* genus, including cultivated crops such as onion, garlic, leek, scallions, shallots, and chives. The larvae of this fly mine the leaves of susceptible plants, and larval mining can cause leaves to twist and curl in onion. Damage by the allium leaf miner can render crops unmarketable and is often an entry door for pathogen infection: in leek, larval mining is often followed by bacterial rot that can completely decimate a harvest. High densities of allium leaf miner have been recorded in its invasive range with as many as 20 pupae per plant and 100% of plants infested in cultivated fields. This species poses a major threat for Allium crop production throughout the northeast and eventually to all North America. Moreover, the genus Allium contains 150+ species in the U.S., including many wild and weedy species. The emergence of this invader may threaten some of the native *Allium* species, while these plants may also serve as potential breeding reservoirs for the pest. Of particular interest is the three-cornered leek, *Allium triquetrum*. This plant is native to Europe and invasive in North America and in various parts of the world. Although it is currently unclear whether or not *A. triquetrum* represents a suitable host plant for the allium leaf miner, its presence could potentially facilitate the spread of the fly in its invasive range. Among the management strategies that can and will be developed to limit the spread and prevent the economic impact of the allium leaf miner, classical biological control shows strong potential. Indeed a variety of parasitoids of the allium leaf miner have been documented in Europe and are thought to play an important role in natural regulation of its populations. Several research questions need to be answered in order to develop a successful biological

control program: 1) what is the geographical origin of allium leaf miner population(s) that invaded the U.S.?; 2) what is the assemblage of natural enemies that attack the allium leaf miner in its native range?; and 3) what is the efficacy and host specificity of these natural enemies? Research on the allium leaf miner started at EBCL in 2019 with high hopes for identifying promising potential biological control agents.

More information on the allium leaf miner may be found at:
-Pest alert from Penn State university: https://ento.psu.edu/extension/vegetables/pest-alert-allium-leafminer
- Barringer et al. 2018. *The First North American Record of the Allium Leafminer*. Journal of Integrated Pest Management 9 (1): 1-8.

Figure 8. Allium leaf miner adult. Photo: L. Donoval

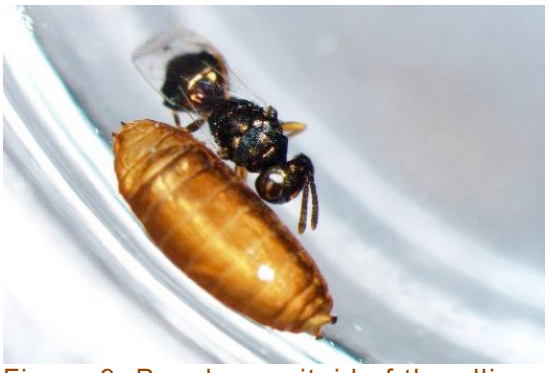

Figure 9. Pupal parasitoid of the allium leaf miner. Photo: D. Roberts

Broadening the tools for recognizing sand fly breeding habitats

by Alexandra Chaskopoulou and Ioannis Giantsis

Sand flies constitute a medically important group of insects due to the transmission of several pathogens in human and domestic animals. While for most insect pests, control of the immature stages is an important part of their management, present information is inadequate to facilitate this strategy for the control of sand fly populations. On account of this limited available knowledge regarding the ecology of the larvae of Phlebotomine sand flies, current vector control techniques are predominantly focused on controlling adult stages. Notably, in US Air Force Public Health Information and Resources report for sand flies is stated "Insecticide spraying of larval habitat is not possible because, usually, so little is known about where the larvae occur". In this context, better understanding of larval ecology will result in designing more efficient and targeted control strategies against *Phlebotomus* species that constitute major Leishmania vectors. In this study we developed a novel molecular approach for the detection of sand fly breeding sites that can be used in the field to increase our knowledge on the ecology of the sand fly immature stages. The results of the study were recently published in Acta Tropica journal and may be downloaded at this link: https://www.sciencedirect.com/science/article/abs/pii/S0001706X18310854?via%3Dihub

« Student Corner »

Student projects at EBCL-France

by Gaylord Desurmont

A new wave of graduate students has arrived at the European Biological Control Laboratory (Montpellier), bringing fresh creative energy to the research projects of EBCL. In total, five M.S. students have chosen EBCL to conduct a 6-month research internship and complete their academic degrees. In detail, Nicolas Lambin (Université Bourgogne Franche-comté, Dijon) is working on characterizing the egg parasitoids of the viburnum leaf beetle *Pyrrhalta viburni* using morphometry and molecular analyses. Mathilde Ponchon (Bordeaux Sciences Agro, Bordeaux) and Maurane Pagniez (ENSAIA, Nancy) are both working on *Bagrada hilaris*. Mathilde is focusing her work on the oviposition preferences of the bagrada bug and Maurane is exploring the endosymbionts of this invasive pest. Priscillia Hanache (Université Jean Monnet, Saint Etienne) works on the behavioral ecology of four species of snails invasive in Australia and her project is a collaboration with the CSIRO European laboratory. Finally, Marion Canale (Sup Biotech, Paris) works on the olfactory

preferences of the olive fruit fly *Bactrocera oleae* in a collaboration with CIRAD (Centre de coopération internationale en recherche agronomique pour le développement, Montpellier) and AFIDOL (Association Française interprofessionnelle de L'olive). It should also be mentioned that Guillaume Martel (SupAgro Montpellier, not in picture) is currently pursuing his PhD at EBCL, working on the ecology of *Bagrada hilaris* and its egg parasitoids. Expect great things from this promising batch of young scientists!

Figure 10. From left to right: Nicolas Lambin, Mathilde Ponchon, Maurane Pagniez, Priscillia Hanache, and Marion Canale. Photo: G. Martel

Student PhD Thesis Defense

by Marie-Claude Bon

On April 25th, 2019, at Hassan II Institute of Agronomy and Veterinary Medicine (IAV Hassan II) in Rabat, Morocco, Salmane Ben-Ghabrit successfully defended his PhD thesis entitled "Invasion dynamics and invasive potential of Silverleaf nightshade (*Solanum elaeagnifolium* Cav.), a Solanaceae threatening the agricultural sector in Morocco" (Figure 11). The thesis was supervised by Professor Bouhache, who, together with Professor Taleb from IAV Hassan II, are internationally known as key authorities in the areas of biology and control of Silverleaf nightshade. Prof. Bouhache requested support from Marie-Claude Bon of EBCL to complete the thesis and to participate on thesis advisory and defense committees.

Native to north-east Mexico and south-west USA, Silverleaf nightshade (Figure 12) is listed as a noxious weed by the federal government in the U.S. in states including Arkansas, Hawaii, Idaho, Oregon, and Washington. Outside its native range, Silverleaf nightshade is considered as one of the worst invasive weeds in the Mediterranean region, including Morocco, in Australia and South Africa, primarily because Silverleaf nightshade causes high yield losses, serves as a host for many pathogens and insects, sucks nutrients from the soil, starves crops of valuable water, and can poison livestock if its berries are ingested. In addition, infested lands lose considerable rental and resale value.

Grounded in years of research on the invasion of the weed and field surveys in Morocco, Salmane's thesis research developed new methodological approaches and concepts to characterize the invasive potential of this weed that will be used to better streamline management efforts in Morocco and eventually in the whole invaded range. Salmane has several publications, and conference presentations to his credit.

Figure 11. Defense committee for Salmane Ben-Ghabrit at Hassan II Institute of Agronomy and Veterinary Medicine in Rabat in Morocco. Left to right: Pr. Mohammed Bouslikhane, Dr. Abbès Tanji, Dr. El Hassan Ben Sellam, Pr. Abdelkader Taleb, Pr. Mohamed Bouhache, Salmane Ben-Ghabrit, Pr. Ahmed Birouk, Dr. Marie-Claude Bon, and Pr. Abdelwahed Maataoui.

Figure 12. Pretty flowers of Silverleaf nightshade, a *Solanaceae* threatening the agricultural sector.

How ARS EBCL student internships can change lives: The story of Katerina, a high school student from the American Farm School (AFS)

by Alexandra Chaskopoulou

The EBCL Sabbatical Program has opened up new pathways for USDA-ARS researchers to perform research overseas in collaboration on projects of common interest. Dr. Lee Cohnstaedt was the first Sabbatical awardee assigned to EBCL-Greece to work for 2 months on insect light attraction on the premises of the American Farm School (AFS) in Thessaloniki where EBCL-Greece is co-located. The onset of the Sabbatical inspired the initiation of a summer internship program aimed to provide a US research experience to one driven and talented AFS high school student with a dream to pursue college studies in the United States. Dr. Alexandra Chaskopoulou in collaboration with the Dean of Student Services at AFS, Ms. Eva Varela-Kanellis, interviewed student applicants to find the one student recipient who would "shadow" Dr. Cohnstaedt. Summer research programs are unique opportunities for students to gain a better understanding and appreciation of science and, also, to demonstrate their skills in research. A summer internship can help a student stand out on their application to university and ultimately show to their future college professors that they are ready to undertake challenging work. USDA-ARS has always been committed to educating students in agricultural research, and high school internships are an effective method to reach out to intelligent young minds and attract them to agricultural sciences, especially to bring women into STEM programs.

Katerina Kargioti, an exceptional senior high-school student, received the internship and as soon as her summer research advisor (Dr. Cohnstaedt) arrived in Greece, she was introduced to the fascinating world of entomology research. Every day that summer she woke up excited to go to the lab to study the behavior of insects by investigating their light preferences – knowledge that would help Dr. Cohnstaedt design more efficient traps for surveillance and control of pathogen-carrying insects, such as mosquitoes and sand flies. She soon discovered that a career in research did not fit into a conventional 8hr-day work schedule and that it took hard work, perseverance and above all passion in order to be successful. It was her desire to learn, her dedication to daily work assignments, and her teamwork spirit that gained everyone's respect and appreciation at the lab. Most importantly she gained the infinite support of her summer research advisor. The excitement of discovery and the pride she felt from her summer experience along with the guidance of her excellent mentor at AFS, Ms. Eva Varela-Kanellis, convinced her to aim high and pursue a research career by applying to her first-choice college: Yale University. A strong application package with an inspiring personal statement about a life-changing summer research experience, a glowing recommendation letter by her ARS summer research advisor (and Yale graduate), and a CV portraying an exceptional student career full of accomplishments resulted in a full scholarship for Katerina to Yale University! Congratulations to Katerina! We all look forward to all the great things she will achieve in her life!

The AFS-EBCL high school student summer research program is continuing for summer 2019 as well. EBCL had multiple applications and this summer's student recipient will "shadow" our new Sabbatical awardee, Dr. Seth Britch from USDA ARS, Gainesville, Florida, who will work on developing the Sterile Insect Technique (SIT) for sand flies.

Figure 13. Ms. Varelas-Kanellis (Dean of Student Services, American Farm School, Thessaloniki, Greece) and Katerina Kargioti - AFS high School student and EBCL summer internship awardee 2018.

Australian Biological Control Laboratory - ABCL

Lygodium Biocontrol Fern Moth/s

by Jeff Makinson

Lygodium microphyllum, Old World climbing fern, is native to the tropical regions of Africa, Asia, Australia and the Pacific. The invasive *L. microphyllum* has spread rapidly since it was first recorded in Florida in 1958 and was considered naturalised by 1965. It is one of the worst weeds in Florida and is listed on the US Federal Noxious Weed list. Its prolific growth rapidly shades or smothers the underlying vegetation including tall trees, promoting fire in plant canopies, changing fire regimes, altering the habitat structure and reducing the native plant diversity.

Commonly known as 'fern moths', *Callopistria* is a worldwide genus of Noctuid moths with well over 100 described species (Figure 14). During ABCL's exploratory surveys for the biocontrol of *L. microphyllum*, *Callopistria* have been found on *Lygodium* species throughout northern Australia (north Queensland, Cape York, the Northern Territory and Western Australia) and in Indonesia, Singapore, Malaysia, Thailand, India, China, Hong Kong SAR and Japan. Some preliminary host-range testing and genetic characterization was conducted in the early 2000s during the initial exploratory phases of the Lygodium project.

The original genetic analyses, conducted between 2000 and 2003 using the D2 nucleotide sequence, suggested that there were three species on *L. microphyllum*: one found in NT and WA; a second in Hong Kong, Thailand and northern Queensland; and the third, a single specimen from southern Thailand.

Over the last couple of years collections from Hong Kong have resulted in a sustained colony at the USDA ARS Invasive Plant Research Laboratory in Fort Lauderdale, Florida, which is suggesting that this species/population is a Lygodium genus specialist with a strong preference for *L. microphyllum* and *L. japonicum*. These specimens have recently been identified as *C. exotica* by Paul Goldstein at the USDA ARS SEL.

Late last year a colony from Cape York was established in the Brisbane labs and comparative host-range tests will be conducted to determine whether there are any host-range differences from the Hong Kong population.

New rounds of genetic analyses have also been conducted, Figure 15. There are some discrepancies between early NT/WA specimens and more recent ones, which may be explained by contamination or parasitic DNA. Otherwise, the results suggest that there are two groups with the bulk of the Lygodium specimens showing some genetic structuring but still closely related and likely to be the same species, at least based on this marker. Given the determination of the Hong Kong population as *C. exotica* this would suggest that the Cape York population will be the same.

More collections are planned for all these populations so that a more complete genetic analysis of the Lygodium *Callopistria* can be made. In the meantime, the need for more agents to help control *L. microphyllum* in Florida is pressing; early indications are that *Callopistria* still has a role to play in addressing that need.

Figure 14. *A Callopistria larva from Cape York, and a Northern Territory adult*

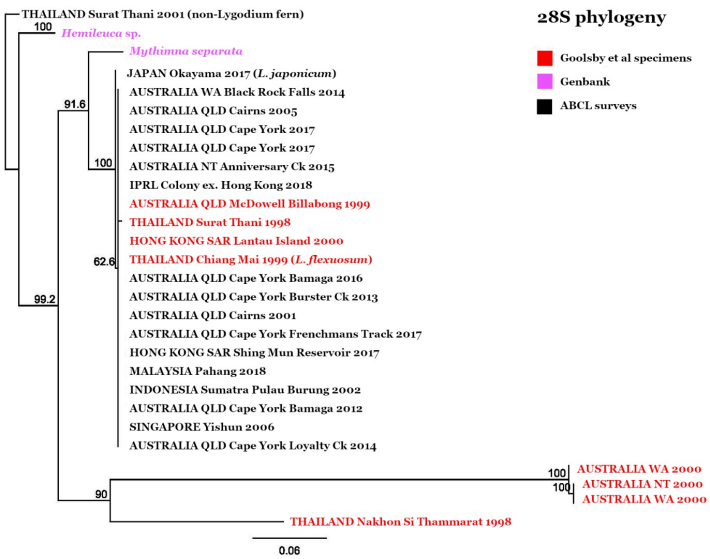

Figure 15. *28S Callopistria phylogeny. Host is L. microphyllum unless stated*

Foundation for the Study of Invasive Species - FuEDEI

Bellyache bush

by Marina Oleiro, Carolina Mengoni Goñalons, & Willie Cabrera Walsh

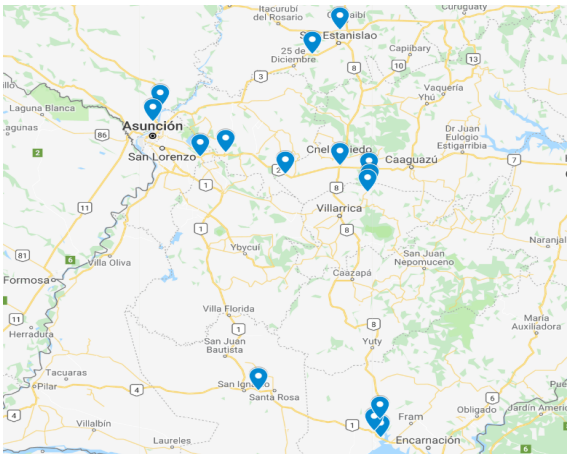

Figure 16. Collection sites of *J. gossypiifolia*.

The bellyache bush, *Jatropha gossypiifolia* L. (Euphorbiaceae), is a shrub native to Central and South America. It is a major and expanding weed of rangelands and riparian zones in dry tropical Australia. Biological control is considered the most economically viable and long-term management solution for *J. gossypiifolia*, which is resistant to herbicides and burning. Native range surveys in Paraguay have identified a leaf-feeding cecidomyiid, which causes shoot-tip dieback on *J. gossypiifolia*, as a potential biological control agent for bellyache bush in Australia.

The cecidomyiid was first collected in Paraguay in April 2012. A more intensive survey in 2013 showed that the shoot-tip dieback on *J. gossypiifolia* was widespread, occurring at 80% of survey sites. Based on morphological criteria, the leaf-feeding cecidomyiid from Paraguay was identified as *Prodiplosis* sp. near *longifila* (Raymond Gagné, personal communication). *Prodiplosis longifila* Gagné is a polyphagous species that attacks several important crop species (citrus, asparagus, alfalfa, potato, tomato, bean, capsicum, cotton, castor oil plant, etc.) in the neotropics. For this reason, preliminary host specificity tests with *P.* near *longifila* must be performed to assure it does not present a threat to species of economic significance.

We carried out five trips to Paraguay between February 2018 and April 2019 and found *J. gossypiifolia* in 15 sites (Figure 16). Shoot tip damage was found in every trip, but was most abundant during summer season (December-March).

No-choices tests using the adults that emerged from the field trips were performed in 120 x 70 cm cages (Figure 17) on six crop species known to host the pest species *P. longifila*. Three pots of the same species were placed inside, and 15 to 20 adults of *P.* near *longifila* were released inside. Seven to ten days after adult release, shootips were inspected for damage. The assay was carried out between January and April 2019.

Results are promising, as none of the six crop species showed damage, whereas all the control replicates of *J. gossypiifolia* showed shoot tip damage (Table 1).

Figure 17. Cages used in the no-choice trials.

	Nº of reps	Nº of shootip damaged	Nº of adults emerged
J. gossypiifolia	6	3 – 9	4 – 14
Tomato	6	0	0
Potato	6	0	0
Round Zucchini	6	0	0
Alfalfa	6	0	0
Cotton	5	0	0
Pepper	3	0	0

Table 1. Results of no-choice tests of the midge *P.* near *longifila*

Distribution and diversity of leaf-cutting ants in northeastern Argentina: species associated to forestry

by Andrés F. Sánchez-Restrepo; Nadia L. Jiménez & Luis A. Calcaterra

Northeast Argentina is the region where the greatest diversity of leaf-cutting ants (LCA) can be found. It is also where around 80% of the country's forest plantations are found. Some of these ants, which feed on fungus cultivated using a substrate of leafs and flowers (Figure 18), are considered among the most destructive pest insects from Argentina to the US (mainly Neotropical). The control of LCA can represent up to 75% of the total budget for pest management in forest plantations, especially during the first three years of the tree's life. Based on data from our surveys and published records, Ecological Niche Models were used to estimate the potential distribution areas of the most relevant LCA in northeastern Argentina, with emphasis on the species most detrimental to forest plantations. We obtained a total of 19 species of LCA distributed in northeast Argentina. Of these, 16 were present in forest plantations and similar productive systems, and up to seven appeared as having a high "pest status" in the model. The species with greatest risk of increasing their incidence and becoming serious pests in forest plantations in northeast Argentina are: *Acromyrmex lundii*, *A. ambiguus*, *A. crassispinus* and *Atta sexdens*. Species richness decreased along the latitudinal gradient between the Misiones province (~14 sp.) and the delta of the Paraná River (4 sp.). Yet the number of high-risk species for forestation was similar throughout the latitudinal gradient, although the high-risk species were not the same throughout the gradient. *Atta sexdens* was the most relevant in Misiones, *A. lundii* throughout the Argentine Mesopotamia and *A. ambiguus* and *A. lundii* in the low basin of the Paraná River. The models generated - like the one shown for *Atta sexdens* (Figure 19)- allowed us to establish the areas where the more damaging species are most likely to be found. This model could help in implementation of control strategies, as it gives a better understanding of LCA current and potential distribution.

Figure 18. Left; leaf-cutting ant carrying a piece of willow leaf. Right; LCA fungus garden.

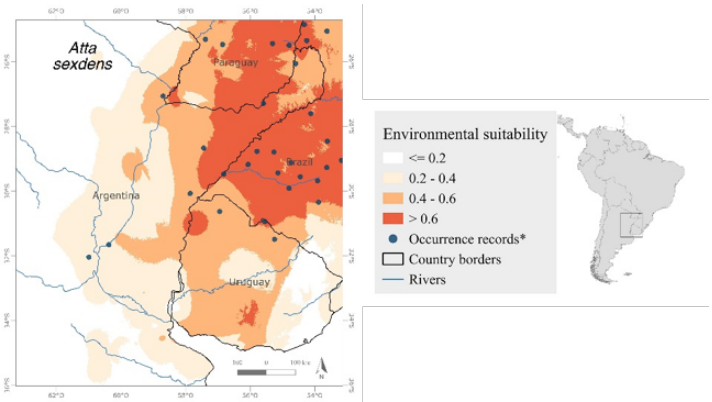

Figure 19. Ecological niche model showing most suitable zones for *Atta sexdens*, a highly damaging species of LCA in the Misiones region.

Figure 20. Example of the damage cause by Leaf-cutting ants in a forest plantation in Buenos Aires (Argentina).

Harrisia Cactus Mealybug

by María Belén Aguirre and Guillermo Logarzo

The *Harrisia* cactus mealybug (HCM), *Hypogeococcus* sp. (Hemiptera: Pseudococcidae), native to South America, is a serious pest of cacti in Puerto Rico (Figure 21), threatening native cacti in the Caribbean and North America. The HCM was first described as *Hypogeococcus pungens* Granara de Willink on the host plant family Amaranthaceae, but its host range includes species from the Portulacaceae and Cactaceae. Beyond its native

range, the HCM has been reported in Australia, the Caribbean, Europe, South Africa and North America. The insect was deliberately introduced in Australia and South Africa, where it provides important control of invasive columnar and climbing cactus.

A classical biological control program was initiated in Puerto Rico to search for natural enemies of the HCM in what was thought to be its South American native range. Initially, the pest species in Puerto Rico, along with the species introduced to Australia and South Africa for control of *Harrisia* spp., and the species attacking Cactaceae and Amaranthaceae in Argentina were all identified as *H. pungens*. As a result of our investigations, a complex of *H. pungens* species was identified. Surveys were conducted in Argentina, Paraguay, Brazil, United States and Puerto Rico for HCM specimens to conduct molecular and morphological identification studies. Associated parasitoids were also reared for identification. Preliminary identification efforts distinguished up to 6 *Hypogeococcus* species that make up the HCM complex, but a more robust molecular genetics technique is required to confirm species separations and their migration relationships. Regarding natural enemies, four species of primary parasitoids were found: *Anagyrus cachamai*, *A. quilmes*, *A. lapachosus*, and another yet undescribed species (Figures 22-24). A specific predator, *Hyperaspis conclusa* was also identified as a common and effective natural enemy. The biological control program against HCM in Puerto Rico is in progress and two parasitoid species from South America were shipped to the quarantine facility at the University of Puerto Rico.

Figure 21. (left) *Pilosocereus royenii* attacked by *Hypogeococcus* sp. in Puerto Rico; (right) *Melocactus intortus* attacked by HCM in Puerto Rico.

Figure 22. Female (left) and male (right) of *Anagyrus lapachosus* Triapitsyn, Aguirre, Logarzo (Hymenoptera: Encyrtidae).

Figure 23. Female (left) and male (right) of *Anagyrus cachamai* Triapitsyn, Logarzo, Aguirre (Hymenoptera: Encyrtidae).

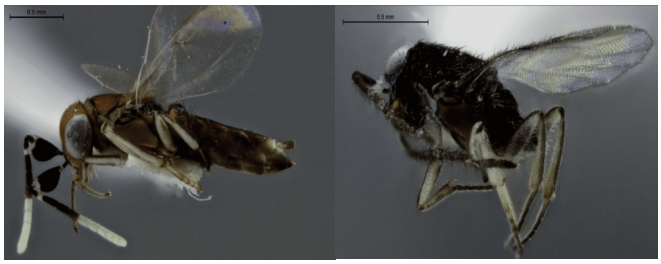

Figure 24. Female (left) and male (right) of *Anagyrus quilmes* Triapitsyn, Logarzo, Aguirre (Hymenoptera: Encyrtidae).

Integrated Management of Water Hyacinth

by Tomas Righetti, Alejandro Sosa, Ana Faltlhauser, and Willie Cabrera Walsh

An invasion of water hyacinth, *Pontederia crassipes* Mart. (Pondeteriaceae) was registered in the *Laguna Del Ojo*, San Vicente, Buenos Aires Province. The coverage of weeds went from 1 to more than 25 ha in two years covering almost the entire body of water, affecting navigation, fishing and tourism: activities of great importance to the local and surrounding communities due to proximity to the city of Buenos Aires. In order to solve this problem, an integrated management strategy (Biological and Mechanical) was designed for this aquatic weed, in collaboration with the community and the local government.

The positive effects of this management strategy were quickly evident, between 2015 and 2018. This was reflected in the decrease in the size and weight of the plants that reduced their biomass and volume by approximately 60%. Control with the weevil, *Neochetina bruchi,* and the planthopper, *Megamelus scutellaris*, was reinforced with the removal of 200 tons of plants with a mechanical shovel, almost completely cleaning the body of water. This meant savings in costs for the community of 40 to 60%. This led an agreement signed between the municipality of San Vicente, the provincial Directorate of Education and Culture, and FuEDEI. This agreement engages the active participation of students and teachers in the community, who are currently rearing the biocontrol agents on school premises, under FuEDEI's guidance (Figures 25 and 26). Currently, the project uses periodic monitoring of the system and development of a small-scale insect mass rearing facility of water hyacinth control agents. These insects are reared in two pools (3-meter diameter, 1-meter high) at Agricultural School No. 1 of San Vicente (Figure 27).

Thanks to this initiative, and for the first time in Argentina (and probably South America), Weed Biological Control became a subject in the school curriculum for 7th year students (the final year). This subject includes an approach to Biological Control theory, with practice on insect collection, mass rearing, and field release of insects in the lake. Students and teachers are supervised by researchers from FuEDEI.

On April 2019, the students and community of San Vicente released *M. scutellaris* and *N. bruchi* (from the school's own culture) (Figure 28). Since then, they have harvested and released insects at least once a month. The multiple stakeholder approach adopted for this project has generated awareness for invasive species, integrated management, and conservation of biodiversity within and beyond the community.

Figure 25. FuEDEI staff and students at Agricultural School No.1 of San Vicente's science fair.

Figure 26. Students manufacturing insect aspirators.

Figure 27. Students showing the mass rearing facility to Bryan Norrington (OIRP Director).

Figure 28. Students first release of *Megamelus scutellaris.*

Sino-American Biological Control Laboratory - Sino-ABCL

Outbreak of the fall armyworm threatens maize harvest in China

by Chenxi Liu

The fall armyworm, *Spodoptera frugiperda* (J.E. Smith), is native to tropical regions of the western hemisphere from the United States to Argentina. It is an occasional, polyphagous, quarantine pest for various countries. It normally overwinters successfully in the United States only in southern Florida and southern Texas. The fall armyworm is a strong flier and disperses long distances annually during the summer months. In 2016 it was reported for the first time in West and Central Africa, threatening Africa and Europe. By the end of 2018, the insect pest had formed a source base in Myanmar. It invaded the western part of Yunnan province in January 2019. This species seems to display a very wide host range, with over 80 plants recorded. The most frequently consumed plants are field corn and sweet corn. In Yunnan, it caused great damage to fresh-eating maize (Figure 29).

Fall armyworm has strong dispersal abilities, and new investigations by the Ministry of Agriculture of China showed the distribution of this invasive pest has expanded northwards into China within several months, including Yunnan, Guangdong, Guangxi, Guizhou, Fujian, Hainan, Sichuan, Hunan, Hubei, Jiangxi, Anhui, Zhejiang, Jiangsu, and Henan (Figure 30). Research Scientists in the Institute of Plant Protection, CAAS, have established a model for its migration routes based on historical meteorological data (Figure 31).

There are various parasitoid natural enemies that may be used to control this pest including *Chelonus texanus*, *Chelonus insularis*, *Telenomus remus*, *Trichogramma pretiosum*, *Archytas marmoratus*, *Cotesia marginiventris*, *Campoletis grioti*, *Ophion* sp., *Archytas marmoratus*, *A. incertus*, and so on. However, no parasitoids have been found in China, which is one possible factor responsible for the serious fall armyworm outbreak and its quick expansion. The Sino-ABCL will now be focused on exploring for natural enemies for biological control of this serious pest.

Figure 29. Fall armyworm feeding on fresh-eating maize in Yunnan.

Figure 30. Fall armyworm has invaded more than 14 provinces in China since January 2019.

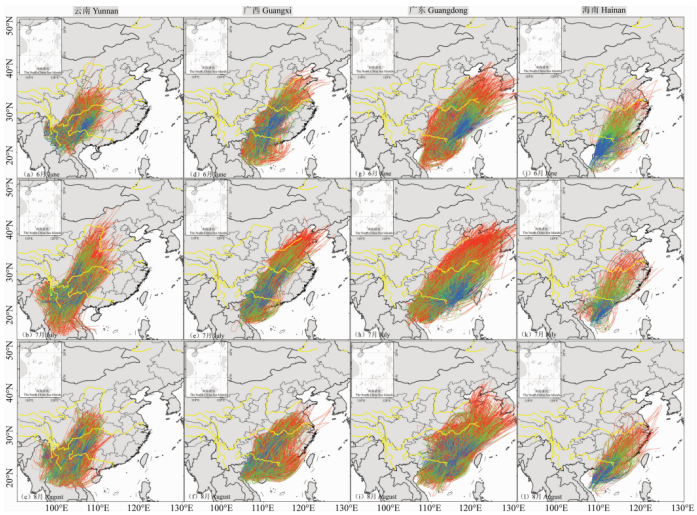

Figure 31. Summer migration trajectories of Fall armyworm from the tropical and southern subtropical zones of China.

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