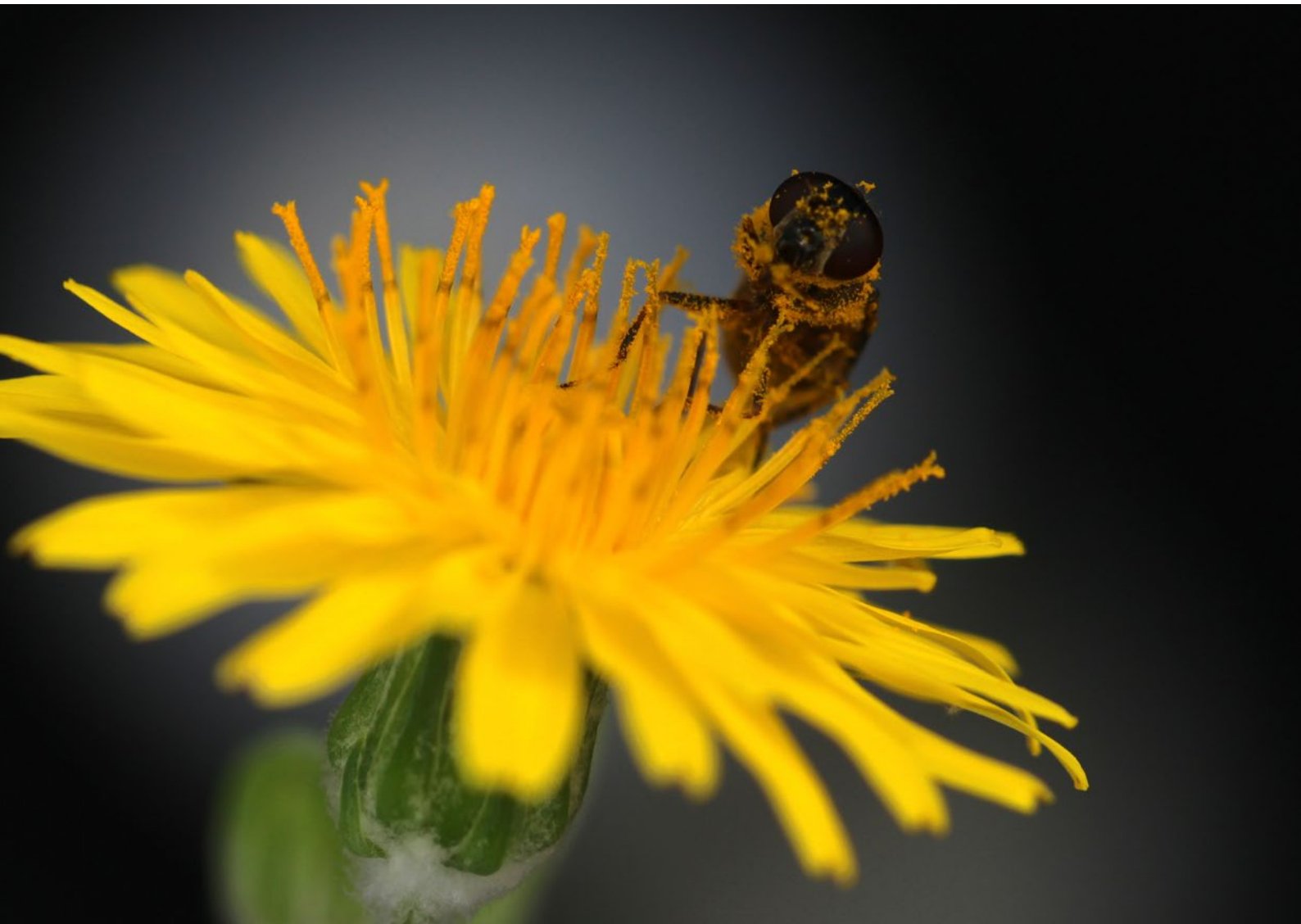
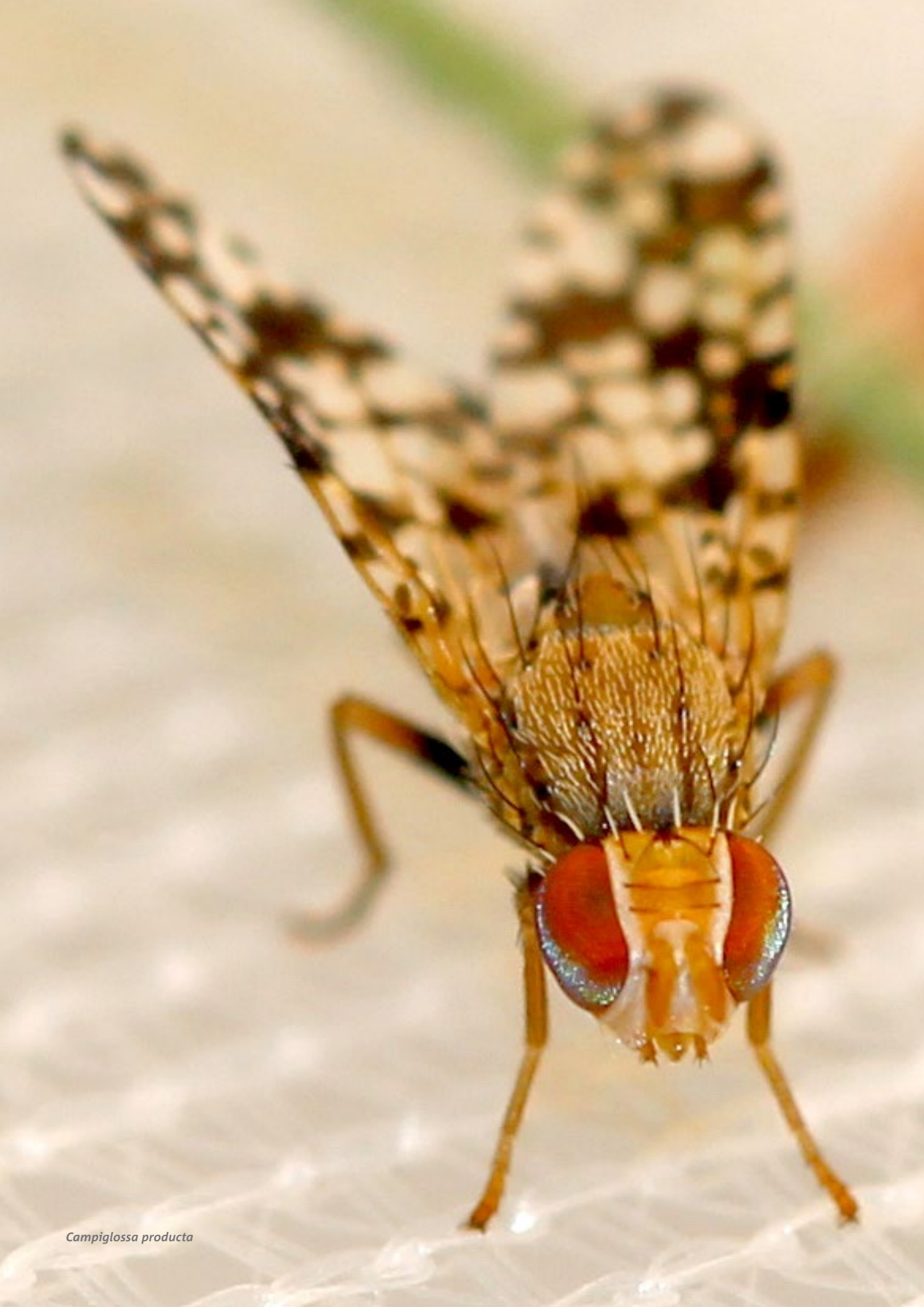
Australia's National
Science Agency

Delivering billion dollar benefits to Australian agriculture and biosecurity

CSIRO European Laboratory





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Director's foreword

Agricultural trading partner countries face many similar challenges. These include new emerging pests, vectors and diseases spread by trade and people movement, declining efficacy and desirability of agro-chemicals, a globally changing climate, global pandemics and greater water constraints threatening food security.

Cutting edge biosecurity is the key to overcoming these challenges and ensuring human wellbeing, agricultural production and growing trade opportunities are not lost. Through agricultural, biosecurity and health science we can prevent the creation of non-tariff trade barriers, sustain increases in crop productivity and reduce the human risks of emerging infectious diseases. To achieve these ambitious goals, research organisations and industry bodies from around the world must work together in collaboration.

French and other EU institutions have worked with Australia's national science agency, CSIRO (Commonwealth Scientific and Industrial Research Organisation), for decades. The CSIRO European Laboratory (CSIRO-EL) has been based in Montpellier for over 50 years. An increasing number of pests and diseases are shared between Europe and Australia, many originating in Europe, the Middle East and North Africa. These shared challenges have long made us natural partners in creating solutions to global biosecurity, agricultural and health issues.

The CSIRO-EL works alongside USDA Agricultural Research Service (USDA-ARS), EMBRAPA, CGIAR and other international agencies as part of Agropolis International, a world class collaboration and innovation hub.

We collaborate directly with USDA, INRAE, L'institut Agro, CIRAD, IRD, CNRS and MUSE University partners on impactful applied collaborative research on pests and weeds of international importance.

CSIRO-EL trains local PhD, Masters and honours students with several students based at the facility each year.

It's also generated nearly $1.4 billion of benefits for Australian agriculture, with a return on investment of at least 27:1.

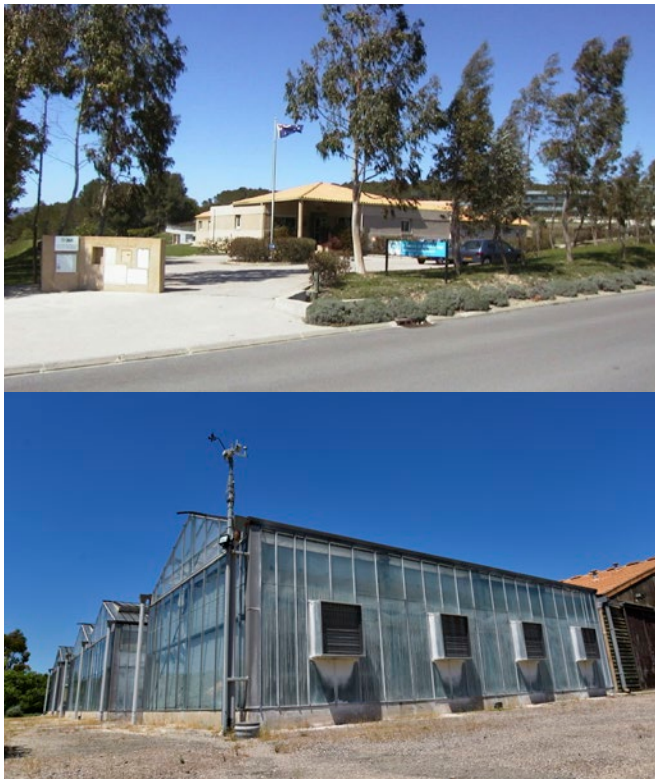
I am extremely proud of the historical collaborative achievements of CSIRO-EL and know that our strong links to the CGIAR Agricultural Research network, location at one of the top three Mediterranean research hubs, and growing research partnerships mean CSIRO-EL will continue to deliver impactful collaborative research and innovation for years to come.

Dr Andy Sheppard
Director, CSIRO European Laboratory

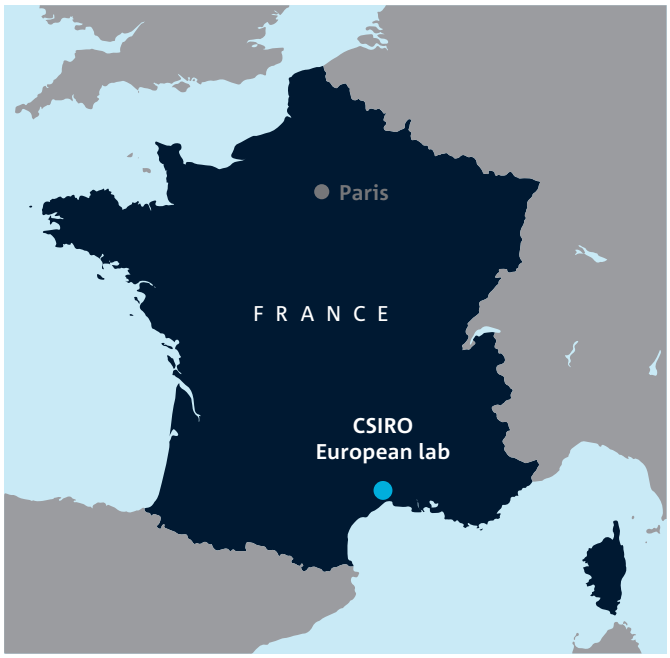
Collaborating with excellence

Agropolis International was established in 1986 to bring together 43 member organisations in the Montpellier region. It was created to facilitate the establishment of collaborative world-class research and innovation hubs to address global, agricultural, biosecurity and health challenges, and international food security.

This consortium of French, European and international partners has established centres of excellence in agriculture, biodiversity and biosecurity research. While focussed on Mediterranean climate areas, large research programs provide developing countries with new technologies and knowledge, helping them create new highly skilled jobs and research impacts.



CSIRO European Laboratory, Montpellier



Agropolis International is home to the main campuses of key French research agencies like INRAE, CIRAD and IRD. Key research areas relevant for Australia are pest and weed management, crop breeding, water management, management of exotic mosquitos and their associated diseases like Malaria and Chikungunya, as well as animal and human health.

CSIRO was the first international member based in Montpellier. We started working with the CNRS in 1966 and built our own facility in 1992. As an active member of Agropolis, the CSIRO-EL staff have helped organise numerous conferences, workshops and contributed to Agropolis publications. CSIRO has also held the presidency of the International Centre for Biological Control (CILBA), the world's largest biological control hub, for several years. Agropolis and CSIRO's presence were strong factors in the USDA-ARS deciding to build its only international owned and run research facility next to CSIRO on the Baillarguet Campus in the late 1990's. USDA-ARS has recently celebrated 100 years of EU based research and development. The headquarters of CGIAR (Consultative Group for International Agricultural Research) also moved to Agropolis in the late 2000's.

Agropolis International

The CSIRO European laboratory is at the heart of a vast Montpellier research community, for which the city has been renowned since the middle ages and where the botanic garden holds some of the first live Australian plants brought to Europe. CSIRO is uniquely placed to instigate new collaborative partnerships in an increasingly broad range of research disciplines and work with French agencies on EU Horizon 2020 partnership programs.

Having a laboratory in such a key European research hub allows for easy creation of new bilateral opportunities for Australian and French businesses. It provides innovative solutions to key challenges and biological threats to the agriculture and food industries, and improves human capital development in both Australia and the EU.

This truly world-class collaboration is supported by CSIRO's major industry and research partners:

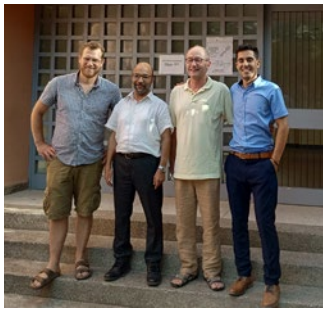
- MUSE Montpellier University of Excellence
- CIRAD Baillarguet and La Valette campuses
- INRAE
- L'institut Agro
- CNRS Centre d'écologie fonctionnelle et évolutive (CEFE)
- CBGP Centre Biologie et Gestion des Populations
- INSERM Occitanie Mediterranee
- IRD
- CGIAR Headquarters
- Biodiversity International
- EMBRAPA – Brazil
- INTA – Argentina
- ICRA
- IMP – Malaysia

CSIRO European Laboratory

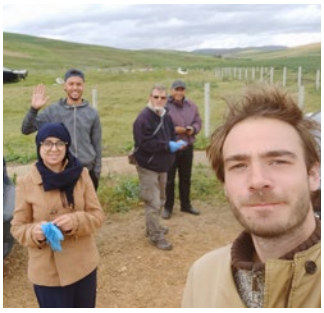
"The CSIRO European Laboratory is driving major health, agricultural and environmental benefits for Australia by integrating capabilities, scientific, environmental and engineering disciplines, against key target pests and diseases."

CSIRO is Australia's national science agency and one of the largest and most diverse applied research organisations in the world. It solves the greatest challenges through innovative science and technology. Our research is world-class and extends into almost all aspects of life and our interaction with natural and man-made environments.

With a 100+ year history, we carry out research in agriculture, health and biosecurity, biodiversity management, land and water management, climate, oceanography and fisheries management, manufacturing and materials as well as in energy, minerals, space and digital information and communication technology, among others. Our strength lies in building expert teams to tackle complex problems and applying large scale, long term and multidisciplinary science to major research challenges.



CSIRO-EL researchers with Moroccan colleagues in front of the museum of Marrakech (Morocco)



CSIRO-EL members and Moroccan collaborators during field research

***Theba pisana* and *Cochlicella acuta*, two pest snail species introduced in Australia, aggregating on a fence post**

***Tephritis formosa*, a candidate agent for controlling *S. oleraceus*?**

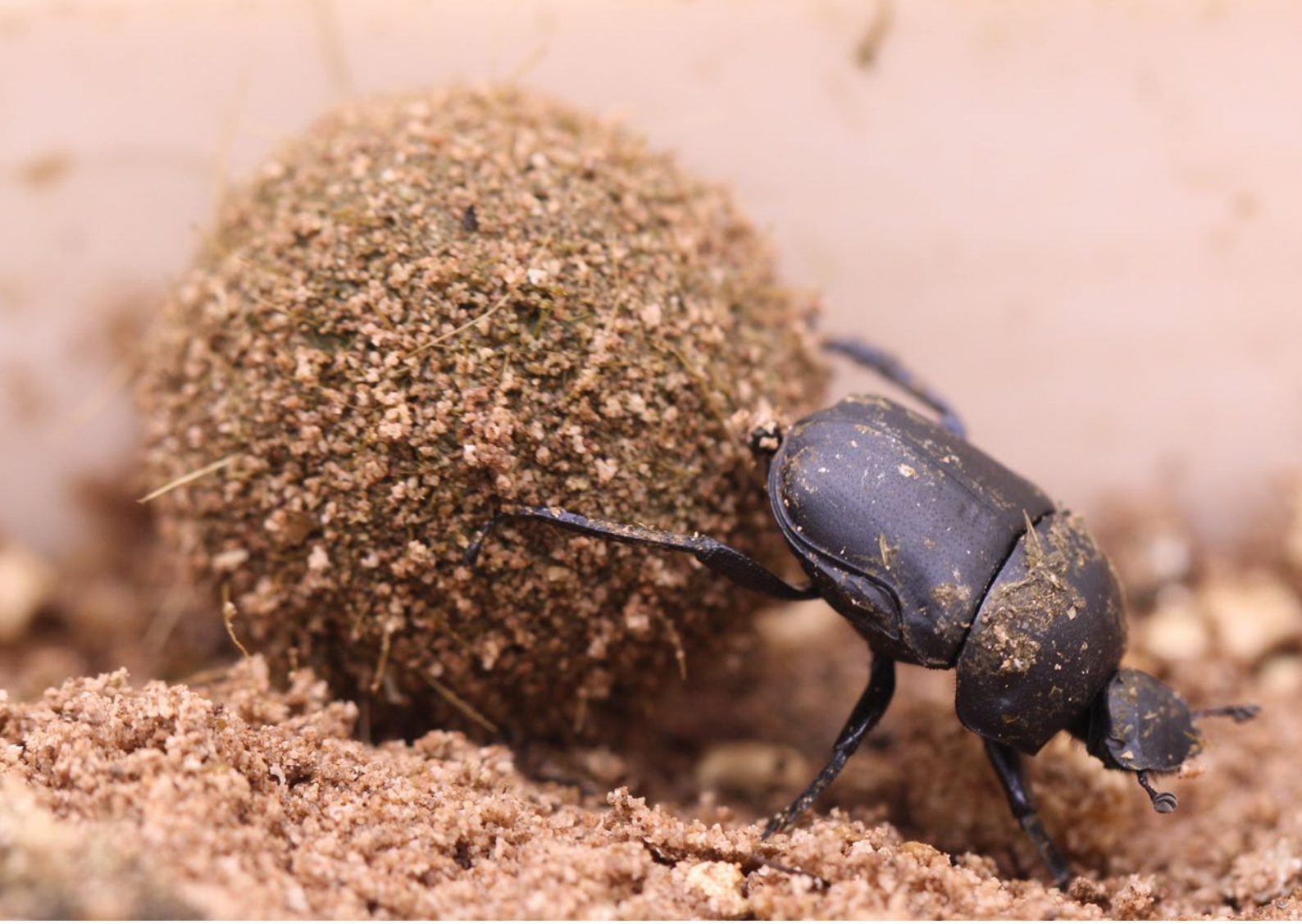
The CSIRO European Laboratory focuses on three research areas:

Biological control of invasive plants

We survey the native range of the plant to identify, select, risk assess, efficacy test, rear and ship biological control agents for a range of agricultural and environmental weeds of European and North African origin. This work has been funded, supported and valued by Australian industry since the late 1960's; including by GRDC, MLA and AgriFutures.

The laboratory undertakes research that cannot be done in Australia. It is based on CSIRO and French science capability and key infrastructure including laboratories, glasshouses and a small containment facility.

This core research has generated $1.4 billion of benefits for Australian farmers, similar benefits for Australian natural ecosystems; and provided translational benefits for European, New Zealand, South African, US and Canadian partners.



Dung beetle

Pre-border biosecurity and biological control

Pre-border biosecurity research cannot be undertaken in Australia and yet is vital for evaluating potential risks and impact should such organisms be introduced. The CSIRO-EL allows Australia to conduct biosecurity research on key pest threats before they arrive in the country. Pests of European origin or already present in Europe can be worked on in semi-natural conditions to better understand biology, crop variety susceptibility, disease vector competence and the genetic basis for hostplant resistance. For example CSIRO-EL led a ten-year GRDC project to protect Australia from the potential impacts of Russian wheat aphid, considered the greatest invertebrate pest threat to the Australian cereal industry. When the pest arrived in Australia in 2017 resistant local cereal cultivars were already known.

Future key targets for Australia include *Xylella fastidiosa*; brown marmorated stink bug ("*punaise diabolique*") and fall armyworm.

CSIRO-EL has also been the centre of invertebrate biological control research, most recently against Mediterranean snails, a key pest and export barrier for Australian grains into Asia.

Dung beetles

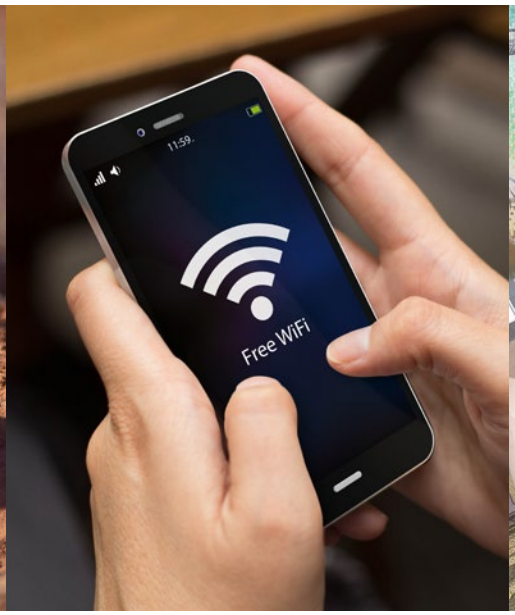
The Australian National Dung Beetle Program is legendary. From the 1960's to 1990's more than 40 species of dung beetle were imported and released into Australia to help bury the more than 80 million tonnes of dung produced each year by Australian livestock and valued at A$13B.

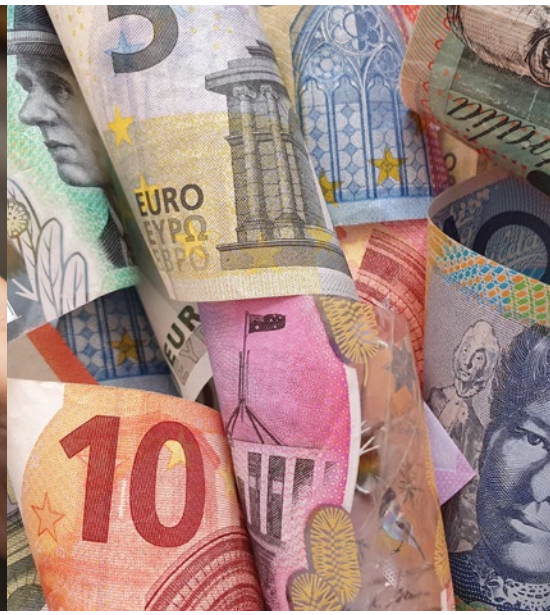
If not for the program, dung would remain on the ground taking up valuable agricultural land, and act as a breeding ground for livestock pests and bush flies. The successful establishment of 23 dung beetle species in the first phase of the program helped the great Aussie BBQ through bush fly suppression along with a multitude of other beneficial ecosystem services.

As Europe was the origin of many of these beetles CSIRO-EL was the hub for identification, selection, biology, rearing and shipment activities. Twenty years on CSIRO-EL is continuing to supply more complementary dung beetles for Australia.

Creating solutions to major challenges

CSIRO has a long history of creating innovative solutions to complex problems for Australia and the international community.





Managing vertebrate pests

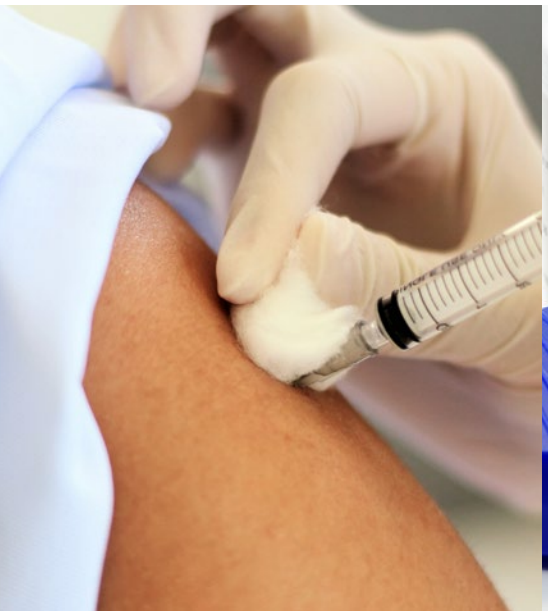
For over 60 years CSIRO has worked with partners in the successful biological control of European rabbits in Australia through the continental scale introduction of two species-specific viruses sourced from Europe. This suppressed pest rabbit populations by 70%, creating over A$70B in benefit to farmers. The same team is now focussing its efforts against European carp.

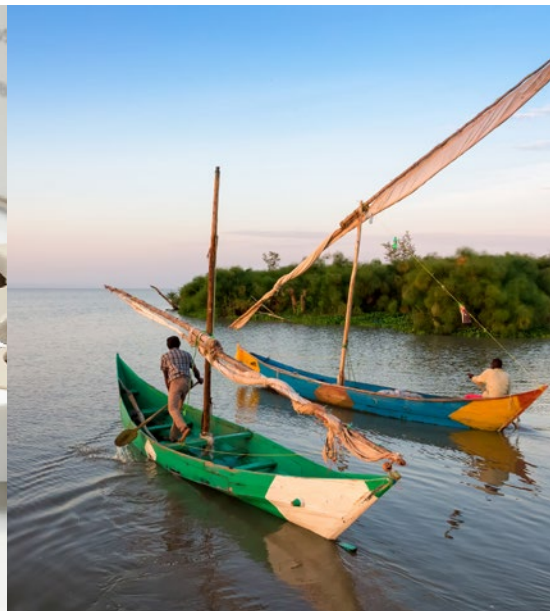
Bringing wireless to the world

CSIRO-developed technology underpins fast Wi-Fi: the wireless local area network systems used in almost every laptop computer and wireless device around the world. The invention has enabled a global revolution in mobile computing and in the way we live and work.

Revolutionising money making

We helped develop the world's first polymer banknotes, which has features such as a see-through panel and hologram that makes counterfeiting more difficult. Today, the technology is used by at least 22 countries with more than three billion polymer notes in circulation.





Preventing iodine deficiency

Iodine deficiency can impede growth and development, particularly in the brain. Our research has shown that iodised oil injections can be used to correct severe iodine deficiency – they have also proven that mental retardation in children can be prevented by injecting patients with iodised oil before pregnancy. This method has been applied on a large scale in Asia, Africa and Latin America with over 100 million doses being given.

Tackling the 'flu

Our expertise in determining protein structure and therapeutic design led to the development of RelenzaTM, the first drug successful in treating the 'flu. Influenza affects as many as 500 million people each year.

Food and Bio Security Aid Programs

CSIRO led the $80M Department of Foreign Affairs and Trade Food Security Aid Program in Africa from 2010 to 2015 through collaborative partnerships with CIRAD, IRD and CGAIR. This generated significantly improved livelihoods for many African communities.

CSIRO research also cleared Lake Victoria of the infamous water hyacinth in the 1990's through the introduction of some beetles from Amazonia. This opened up clear water for hundreds of African communities around the lake.

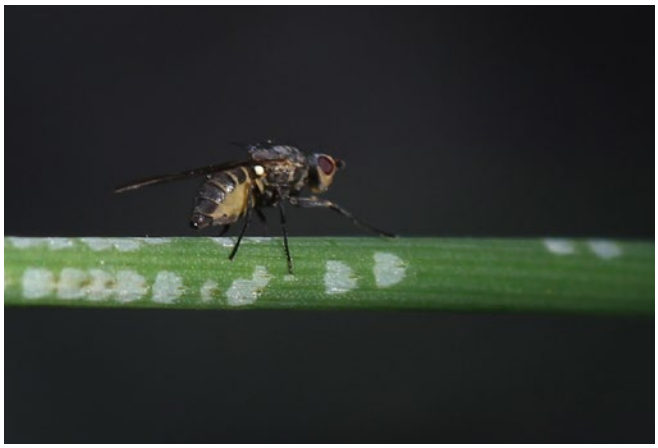
Leading in agricultural and biosecurity research

CSIRO is a leader in agricultural, environmental, health and biosecurity research. We work with new technologies to increase sustainable agricultural production and natural resource use, improve human health systems and global free trade, and keep food security free from biological threats. We work with the commercial sector to deliver novel outputs and innovative products, support new start-ups and digital service industries, and clean commodities for better market access.

Autonomous biosecurity

As free trade increases new biosecurity and food safety risks quickly emerge, blocking trade or generating trade risks for our exports and imports.

Many of these risks are easy to predict and autonomously manage along supply chains to keep market access open, but current processes to manage this are still in the 20th Century. CSIRO is creating Big Data analytical systems and Artificial Intelligence platforms to digitise and step change efficiencies of biosecurity risk analysis and compliance requirements for governments and industry. This will allow the Australian biosecurity system to grow, adapt to increasing trade and people movement, and improve its efficiency.



Next generation diagnostics

Endemic diseases continue to cost Australian agricultural profitability and sustainability more than A$3B a year. CSIRO is building new technologies to improve animal disease management through on-farm tools that allow much more rapid disease detection and response, enhance antimicrobial resistance stewardship, and support development of disease resistant breeding lines. These tools will increase farm profitability and drive improved consumer confidence in Australia agriculture; providing biosecurity, social, animal and plant health benefits along the way.

Stakeholder analyses ensure that technologies are delivered in socially responsible ways that reflect the needs of primary industries.

Gene-tech for pest and disease management

Australia's biodiversity is in rapid decline because of the massive impacts from invasive species, diseases and their vectors; as well as low gene diversity and resilience among native fauna and flora. National assets and people are also under threat from increasing disease outbreaks and the threat posed by diseases such as Dengue and Foot & Mouth Disease.

Threats from human diseases transmitted by arthropod vectors are another increasing national challenge that can be addressed.

CSIRO is evaluating gene technologies that can turn the tide, rebuild resilient native populations, and develop new tools to eradicate the invasive species and diseases that have plagued our continent for generations.

The Australian Centre for Disease Preparedness

Bioinformatics and Big data

State of the art gene editing tools like CRISPR have created the age of Big Data bioinformatics. Harnessing genomics, proteomics, transcriptomics, metabolomics and lipidomics will help manage genetic issues for humans, as well as the plants and animals we depend on.

CSIRO is building the capability to create, collate and analyse such data and quickly translate it into information for supporting a healthy and resilient community.

Addressing emerging infectious diseases

New zoonotic diseases are emerging out of a closer association between humans and wild animals. COVID-19, virulent flu strains, SARS, EBOLA, MERS, Hendra, and Nippa have all developed as major threats to the global population in the last 20 years. New diseases and virulent strains will continue to emerge.

Meanwhile, increasing antimicrobial resistance is also compromising global health resilience.

Pandemics can be prevented though if we follow disease strain evolution around the world and know what we are dealing with soon after detection.

CSIRO's Australian Centre for Disease Preparedness (ACDP) helps with this, by discovering and rapidly detecting diseases and virulent strains, as well as developing vaccines and other therapeutic solutions.

As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.

CSIRO. Unlocking a better future for everyone.

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Cover image: Cheilosia latifrons on a Sonchus flower

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