

The REACT Newsletter

ISSUE #03

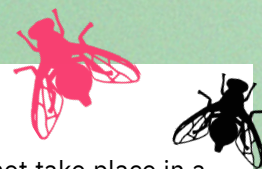
October 2025



Funded by
the European Union

REACT

Editorial



Dear Readers,

One of the most important conversations of the REACT project this year did not take place in a laboratory or at an outdoor research site, but in a meeting room at the General Assembly in Parma, Italy. During our stakeholder event – “Bridging Innovation and Regulation: Pathways for Sterile Insect Technique in Europe” – we brought together researchers, regulators, NPPO experts and agricultural stakeholders to address a key issue: how can we transition the Sterile Insect Technique (SIT) and related innovations from experimental settings to approved, real-world applications?

As a biologist studying the genomic, molecular, and physiological bases of insect reproduction, I have seen first-hand how REACT’s science has evolved and matured. Over the past three years, our teams have made significant progress – generating new insights that support the development of successful novel genetic sexing strains, testing them under realistic field conditions, and advancing analytical tools such as metabolomic and molecular markers of male quality – that will enhance the effectiveness and scalability of SIT. Yet, as we discussed in Parma, scientific progress must go hand in hand with regulatory preparedness. The timing of this conversation could not have been better— nor the location more appropriate, given Parma’s role as the home of the European Food Safety Authority (EFSA).

The stakeholder dialogue began with reflections on invasive species, innovation, and regulatory preparedness delivered by Prof. Marc Schetelig, followed by Prof. Nikos Papadopoulos, who presented REACT’s integrated model for site-specific SIT strategies against invasive pests. Together, their presentations set the tone for a broader discussion on how science can advance sustainable, precision-based pest management in Europe. The format then moved toward evaluation, risk assessment, and regulatory processes, with contributions from Dr. Giuseppe Stancanelli and Dr. Tommaso Raffaello (EFSA), and Dr. Mara Sgroi (DG SANTE, EC), who outlined an evolving EU policy framework – notably referencing the upcoming proposal on plants obtained by new genomic techniques. Their insights underscored how experiences from plant biotechnology and conventional pest management can guide the regulatory pathway for future SIT applications.

In the final panel, participants reflected on a shared conclusion: that SIT approval is not merely a regulatory hurdle, but a matter of readiness, trust, and coordination. While the science is robust, many Member States still lack clear procedures for evaluating or authorising SIT-based control, particularly when it involves genetically modified insects. The result is regulatory ambiguity and hesitation, even when effective and environmentally sound tools are available. In Parma, we heard that new admission strategies do not necessarily need to be reinvented: existing plant health frameworks could be adapted to include the SIT, particularly if supported by robust monitoring, risk assessment, and traceability measures. Others pointed to the importance of harmonised EU guidance and evidence-based policy recommendations, a space where REACT’s research can make a real contribution.

As the project draws to a close, I believe this dialogue will stand among REACT’s most important legacies. Alongside our scientific and technical achievements, we must help build the policy foundations that allow these advances to have impact. In this sense, SIT admission strategies are not a separate track – they form part of the core architecture of REACT. Ultimately, these efforts are about people: the growers who need reliable tools to protect their crops, the regulators who must ensure safety and effectiveness, and the public whose trust will determine the success of innovation. As Parma reminded us, bridging science and policy is not just desirable – it is essential. And REACT is ready to play its part.

Francesca Scolari

Biologist

Consiglio Nazionale delle Ricerche | Pavia, October 2025





Introduction

2025 was a defining year for REACT, marked by **scientific progress, cross-border collaboration and increasing public visibility**. Teams across the project have made significant strides in areas ranging from genetic pest control to microbial ecology, field modelling and governance. The results of this work are beginning to emerge **not just in the laboratory, but also in publications, practical tools, and early-stage implementation**. In this issue, you can explore some of these key advances and discover the connections between disciplines and regions.

We've also expanded our storytelling. Short videos from REACT labs and field sites have helped **make the project more visible — and more accessible**. We'll continue using this format to open up the research and introduce the people behind it.

Most importantly, REACT is not just about producing knowledge — it's about supporting those who use it. In this newsletter, you'll find **updates on our engagement with NPPO experts and growers, whose decisions on crop protection are at the centre of it all**. We invite you to explore, watch, and read — and to join the conversation.



In this Newsletter:

- 4** REACT's Advances: From Innovation to Implementation
- 6** New Project Videos
- 8** Interview: Angela Meccariello (ICL)
- 11** Citizen Science
- 12** News and Events
- 14** REACT Scientific Publications
- 15** Contact and Links

From Innovation to Implementation: How REACT is Building a Smarter Response to Fruit Fly Invasions

As fruit fly incursions continue to threaten agriculture and biodiversity in various regions, REACT's third year marks a shift from exploratory research to actionable strategy. What started as a multidisciplinary investigation into genetics, modelling, microbial ecology and governance has evolved into a coordinated response system designed to provide rapid, science-based interventions against invasive species of fruit fly. This year's work is not just about making progress in individual areas, but also about building bridges between them.

One of the key developments this year has been the ongoing refinement of tools for genetic pest control. In London, for example, researchers at Imperial College have developed improved protocols for Y-chromosome engineering in the Mediterranean fruit fly by using the CRISPR-Cas9 system to integrate male-specific fluorescent markers. These proof-of-concept lines offer valuable insights into the feasibility of early sex separation for Sterile Insect Technique (SIT) strategies and are paving the way for application in quarantine-relevant species, such as *Bactrocera dorsalis* and *B. zonata*. Meanwhile, teams at Justus-Liebig-University Gießen are making progress with autosomal sexing approaches, offering an alternative way to develop Genetic Sexing Strains (GSS) that are scalable and stable. Field validation and mating performance assessments are underway with project partners in Israel, closing the loop between laboratory innovation and deployment readiness.

However, REACT's vision extends far beyond genetics. In year three, a major focus has been to ground scientific advances in realistic ecological and operational scenarios. Experimental fieldwork and overwintering trials, including those conducted in Vienna, Naples, Thessaloniki, Valencia and Crete, are providing essential data for population models. These studies are helping to refine the PESTonFARM sub-models, improve pest distribution predictions and simulate outbreak scenarios under different climate and land use conditions.

Meanwhile, the project's microbial ecology research is continuing to explore the impact of symbiotic bacteria on host fitness and pest dynamics. Microbiome analyses have revealed consistent patterns in the gut microbiomes of various species and strains. Laboratory experiments have begun to demonstrate competitive interactions between microbial candidates, providing insights that could inform future pest suppression strategies. At the same time, horizontal gene transfer and biosafety concerns are being systematically assessed, with current findings indicating that the risk is minimal under the tested conditions.

At the intersection of science, policy and practice, REACT has made significant progress towards implementation. Teams working on governance and socioeconomics have conducted stakeholder interviews and regional surveys to identify the main obstacles to the adoption of biocontrol. These findings are now informing the development of the Rapid Reaction Manual, a science-based, modular guide to responding to fruit fly invasions. The manual synthesises information on pest biology, surveillance techniques, legal frameworks and control options — both conventional and genetic — to provide a practical decision-support tools. Expert reviews and consultations have helped to ensure that the manual is aligned with the operational realities of national plant protection systems.

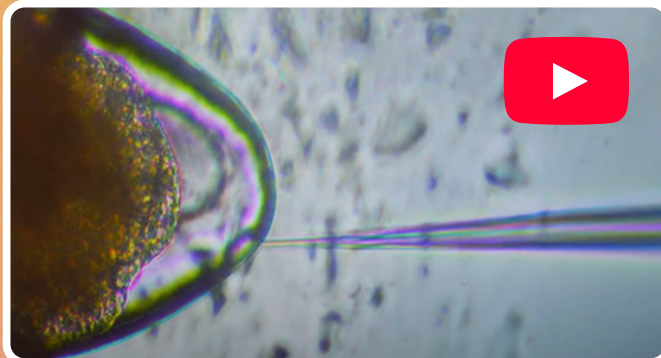
As the project enters its final year, a broader picture is emerging. The work packages, ranging from molecular biology and field modelling to regulatory mapping and public engagement, are coming together to form a unified system architecture. REACT is not just developing a set of novel tools; it is creating a practical, cross-border framework for coordinated pest control in Europe and beyond.

Crucially, the conversation around regulatory pathways for genetic biocontrol is now moving beyond the theoretical stage. With proof-of-concept trials, robust safety data and increasing stakeholder involvement, the project is now ready to engage meaningfully with regulators. The question of how, and under what conditions, these tools might one day be authorised for use is becoming both timely and tangible. This discussion is a milestone in its own right.



Meet Serafima Davydova: Developing Genetic Tools for Pest Control

Meet Serafima Davydova, PhD researcher at Imperial College London and lead author of two breakthrough papers on genetic sexing strains in fruit flies. In this interview, she explains how CRISPR-based tools are opening new possibilities for next-generation Sterile Insect Technique (SIT). Her work directly supports REACT's mission to develop scalable, precision-targeted pest control solutions.



Engineering Precision: Genetic Sexing Strains at Imperial College London

This video takes you inside the REACT project's cutting-edge research at Imperial College London, where scientists are developing genetic sexing strains and Y chromosome markers to make pest control smarter, safer, and more targeted. A behind-the-scenes look at science with real-world impact.



REACT: Exploring the Socio-Economic Impact of Sustainable Pest Control

Discover how smart pest control can do more than just fight bugs—it can transform communities! This video explores the REACT project's sustainable strategies against invasive pests in Europe. See real-life impacts on farmers, local economies, and ecosystem health as science meets social change on the ground.



INTERVIEW

Angela Meccariello

Angela Meccariello

Behind the Microscope: Engineering the Future of Pest Control at Imperial College London



Hidden away in a lab at Imperial College London, a team of researchers is taking on one of the most ambitious technical tasks of the REACT project: integrating genetic markers into the Y chromosome of the Mediterranean fruit fly (*Ceratitidis capitata*). The goal? To develop a new generation of genetic sexing strains (GSS) that will enable more efficient and environmentally friendly pest control of insects.

At the heart of this endeavour are three researchers: senior researcher Dr Angela Meccariello, PhD student Serafima Davydova, and laboratory technician Jonathan Mann. Together, they combine cutting-edge CRISPR tools with the patience and precision required to inject, screen, and raise tens of thousands of insects. We spoke to Dr Meccariello about the scientific challenge they are tackling and how their work connects to the broader goals of the REACT consortium.

Let's start with the basics. What exactly is your team at Imperial working on within REACT?

Our lab specialises in developing genetic sexing strains, particularly through Y-chromosome engineering in the Mediterranean fruit fly. We use CRISPR-Cas9 technology to insert transgenes into specific regions of the Y chromosome. These transgenes could include visible markers, such as green fluorescent protein (GFP), or functional genes that create a sex-linked phenotype — for instance, pupae that change colour depending on sex.

Dr Angela Meccariello

Angela Meccariello is a molecular entomologist at Imperial College London, specialising in genetic pest control.

As a senior researcher in the REACT project, she leads the development of Y-linked genetic sexing strains in the Mediterranean fruit fly, combining CRISPR-based genome editing with applied insect genetics to support next-generation Sterile Insect Technique strategies.





The aim is to separate the male and female insects before they emerge, which is crucial for the Sterile Insect Technique (SIT). Under the SIT, only males are released into the environment, so sexing strains can reduce costs and increase efficiency while avoiding the accidental release of female pests.

In REACT, our task is to generate Y-linked GSS that can later be adapted to other pest species. We are developing the genetic tools that will make scalable, precision-targeted pest control possible.

But REACT's target pests aren't Medflies – they're *Bactrocera dorsalis* and *Bactrocera zonata*. Why are you working on *Ceratitis capitata* instead?

Yes, REACT's ultimate goal is to develop SIT-compatible genetic sexing strains for *Bactrocera dorsalis* and *Bactrocera zonata*, which are both highly invasive and economically damaging pests. But working directly with these species comes with significant limitations. First and foremost, they are classified as quarantine pests in much of Europe. That means their import, rearing, and handling are subject to strict biosafety and legal restrictions — in many countries, including the UK, it's simply not allowed to work with them in open laboratory conditions.

From a technical standpoint, these species also lack established genetic tools. The genomes are more complex, less annotated, and protocols for embryo injection or transgenesis are still in their infancy. So rather than building everything from scratch under regulatory pressure, we use the Mediterranean fruit fly (*Ceratitis capitata*) as a proxy model.

The medfly is genetically tractable, its genome is well-studied, and we have access to long-established lab strains like Binakion. It allows us to test, refine, and validate our genetic tools — including Y-linked integration and sexing markers — in a controlled, legally compliant environment. Once the tools are working in medfly, we can collaborate with partners in REACT who have the capacity to transfer and validate them in *Bactrocera* species under appropriate conditions.

What makes Y chromosome engineering in medflies such a technical challenge?

Work on the Y chromosome is tricky for two reasons. Firstly, the Y chromosome largely consists of heterochromatin, which is condensed and mostly inactive. Even when we succeed in integrating our marker gene, as we have done, it often fails to express because it lands in a transcriptionally silent region.

Secondly, the process itself is very demanding. Serafima and Jonathan spend hours at the microscope first rearing and preparing, and then manually injecting freshly laid eggs with our CRISPR-Cas9 master mix. The embryos are tiny and fragile, and precise timing is crucial — the eggs must be maximum 45 minutes old.



Photo: REACT

After injection, the flies are reared throughout their entire life cycle. We then screen the next generation — the G1 flies — for marker expression using fluorescence. If a green glow appears in the male pupae, we know we're on the right track.

That sounds incredibly meticulous. How do you coordinate that kind of complex workflow in the lab?

It's a real team effort. Serafima is primarily responsible for performing the embryo injections, optimising the injection protocols and screening the resulting lines. Jonathan supports all aspects of life-cycle management, from egg collection and handling to rearing and pupal screening, and also assists with technical troubleshooting.

The key to this work is precision, consistency and communication. If any part of the workflow falters — if the eggs are too old, the glue isn't right or the injection pressure is incorrect — you risk losing an entire batch. Our team therefore operates like a small orchestra, with everyone tuned to the rhythm of the flies.

How does your work at Imperial connect with the broader efforts of the REACT consortium?

REACT is founded on specialisation and synergy. While our focus is on molecular genetics and genome engineering, other teams are working on field trials, mass-rearing or alternative sexing strategies. At Justus-Liebig University Gießen, for instance, our colleagues are developing autosomal GSSs using classical genetics and non-Y-linked markers. These approaches are often more robust for immediate implementation and provide valuable reference points for mass-rearing facilities.

In Israel, our partners at the Volcani Center have extensive experience in large-scale insect production and field deployment. They test mating competitiveness and help evaluate whether a given GSS will perform reliably outside the laboratory. Together, we are building a pipeline from genome to greenhouse, starting with fundamental genetic tools here in London and then validating and scaling them through collaborative testing across Europe and beyond.

Beyond the lab, what kind of impact could this work ultimately have?

If we succeed in developing a reliable and expressive Y-linked GSS in the Medfly, we will not only enhance current SIT programmes, but also provide a template for future applications. Our constructs are designed to be modular, meaning they could potentially be adapted for use with other pest species of agricultural concern.

Furthermore, this work contributes to the long-term goal of reducing reliance on pesticides. Methods of genetic control like SIT are species-specific, non-toxic and environmentally sustainable. They align well with the EU's goals for greener agriculture and biodiversity protection.

Beyond the technical gains, we are helping to train a new generation of researchers in complex genome engineering, molecular biology and translational entomology.





Looking ahead, what are the next steps — and the long-term vision — for your team's research?

We're at an exciting turning point. We have achieved multiple Y-chromosome integrations, which shows that our CRISPR-Cas9 constructs are landing where intended. The challenge now is to achieve consistent expression of our marker gene, which is most likely due to integrations occurring in highly condensed, non-expressive regions of the Y chromosome.

The next step is therefore twofold: first, we will continue to screen new insertion sites and optimise our protocols, from injection conditions to marker design. Secondly, we will begin testing our constructs in hybrid genetic backgrounds to assess the stability and visibility of these markers across different Medfly strains.

Beyond that, I believe we're close to achieving proof of concept for a Y-linked GSS that demonstrates the feasibility of sex separation via a transgenic Y marker. Once that is in place, we will explore transferring the strategy to other pest species.

In parallel, we are developing a suite of complementary CRISPR tools that go beyond Y-linkage, including female-to-male sex conversion and conditional sterility systems. One of our recent preprints describes how the targeted disruption of the transformer gene can generate female-less populations with high precision. This opens up new avenues for population control.

In the long term, our vision is clear: to contribute to a flexible, modular SIT platform that can be adapted across pest species and regions. If our work can help to reduce pesticide use, improve sustainability and make pest control more science-based, that would be an outcome we could be proud of.

In 2025, the lab has published two papers that mark significant milestones on the way toward SIT-compatible genetic tools:

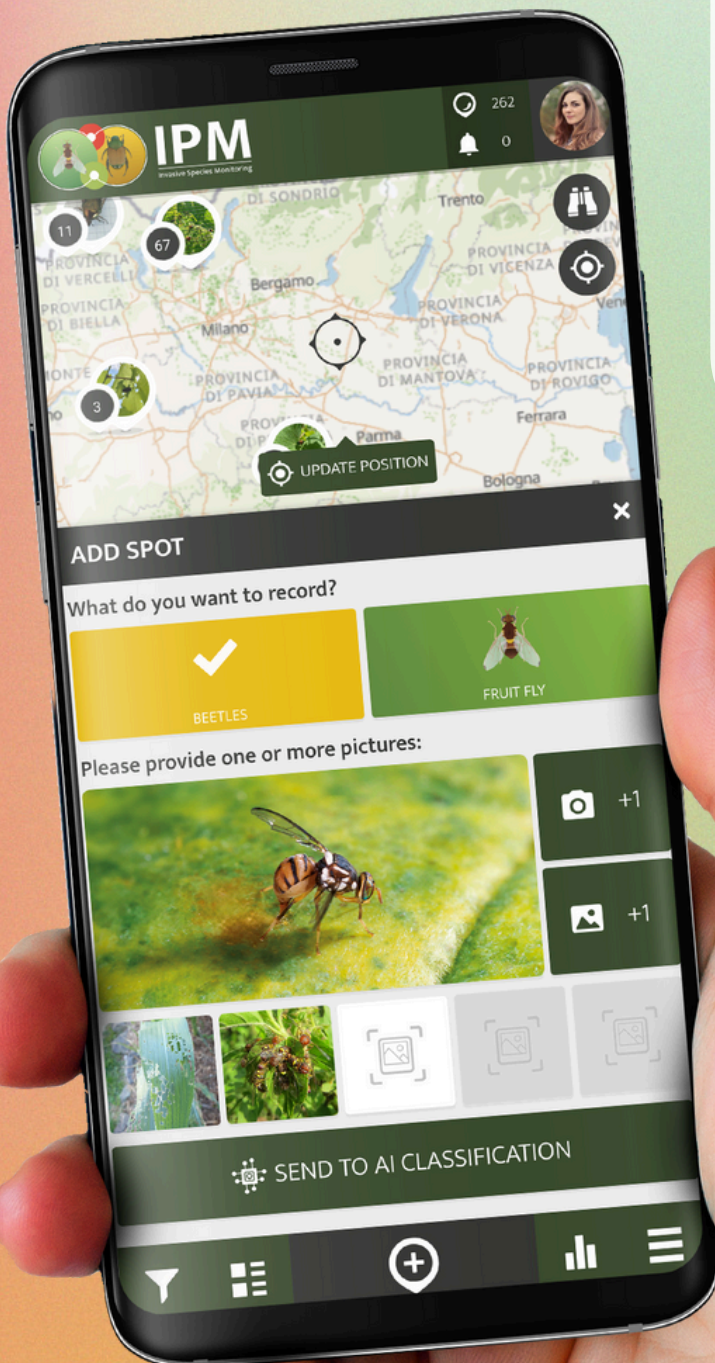
Davydova, S., Liu, J., Prince, K., Mann, J., Kandul, N., Braswell, E., Akbari, O., & Meccariello, A. (2025). A self-limiting sterile insect technique alternative for *Ceratitidis capitata*. *Insect Science*, 0. <https://doi.org/10.1186/s12915-025-02201-2>

Davydova, S., Yu, D., & Meccariello, A. (2025). Genetic engineering for SIT application: a fruit fly-focused review. *Insect Science*. *Insect Science*, 0, 1–21. <https://doi.org/10.1111/1744-7917.7003>





Join and help prevent the spread of invasive fruit flies in your region.



REACT Stakeholder Meeting in Parma (October, 2025)

On 10 September 2025, REACT welcomed stakeholders from across Europe to a dedicated meeting at the NH Hotel in Parma, Italy. The event brought together scientists, regulators, and practitioners to discuss the latest progress in Sterile Insect Technique (SIT) research and the regulatory frameworks that will determine its future application in Europe.

[Read more online](#)



Photo: REACT

REACT Engages Media in Naousa to Showcase Localised SIT

Early in September 2025, REACT welcomed a group of international journalists to Naousa.

The visit coincided with the field release of sterile Mediterranean fruit flies, part of REACT's effort to demonstrate a locally deployable Sterile Insect Technique (SIT).

[Read more online](#)



Photo: REACT

Exploring at the Metabolomics Academy (May, 2025)

In late May, the CNR Institute of Bioinformatics and Structural Biology hosted the Metabolomics Academy: Applications for One Health, a week-long training within ELIXIR-IT.

Marcella Bonanomi presented REACT's work on tephritid fruit flies, sharing protocols for metabolite extraction and efforts to identify molecular markers of male quality to support Sterile Insect Technique (SIT) strategies. Her talk effectively linked metabolomics fundamentals to applied research.

Daniela Gaglio and Tecla Aramini also represented REACT as part of the organising team and contributed throughout the week.

The academy was a valuable opportunity to share REACT's work and engage with emerging researchers in the field.

[Read more online](#)



Photo: REACT

REACT Publications

Aumann, R. A., Gouvi, G., Gregoriou, M.-E., Rehling, T., Sollazzo, G., Bourtzis, K., & Schetelig, P. D. M. F. (2025). Decoding and engineering temperature-sensitive lethality in *Ceratitis capitata* for pest control. In PNAS (Bd. 122, Nummer 28, S. 1–8). <https://doi.org/10.1073/pnas.2503604122>

Prates, L., Aumann, R. A., Sievers, I., Rehling, T., & Schetelig, P. D. M. F. (2025). Functional validation of a white pupae minimal gene construct in *Ceratitis capitata* (Diptera: Tephritidae). In Insect Science (Bd. 0, S. 1–14). John Wiley & Sons Australia.

Lux, S. A., & Colacci, M. (2025). Adaptation of the PESTonFARM Model to Support Decision-Making and Planning of Local Implementation of the Sterile Insect Technique in the Control of *Ceratitis capitata* Flies (Diptera: Tephritidae). In Applied Sciences (Bd. 15, Nummer 12, S. 6694). MDPI. <https://doi.org/10.3390/app15126694>

Davydova, S., Liu, J., Prince, K., Mann, J., Kandul, N., Braswell, E., Akbari, O., & Meccariello, A. (2025). A self-limiting sterile insect technique alternative for *Ceratitis capitata*. Insect Science, 0. <https://doi.org/10.1186/s12915-025-02201-2>

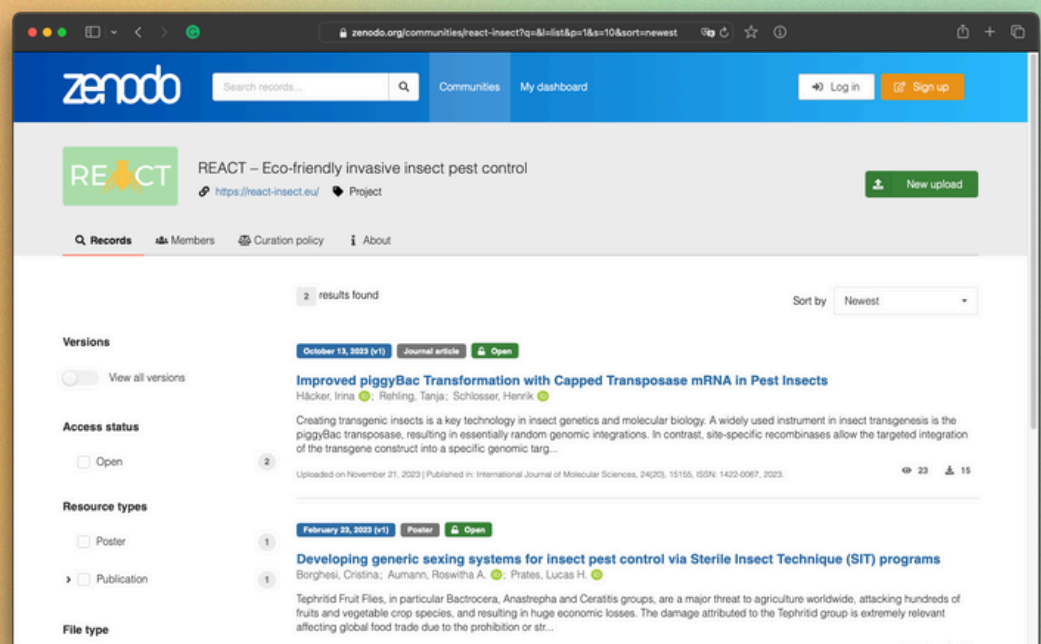
Davydova, S., Yu, D., & Meccariello, A. (2025). Genetic engineering for SIT application: a fruit fly-focused review. Insect Science. Insect Science, 0, 1–21. <https://doi.org/10.1111/1744-7917.70038>

Rallis, D., Tsoumani, K. T., Krsticevic, F., Papathanos, P. A., Mathiopoulos, K. D., & Papanicolaou, A. (2024). Revisiting Y-chromosome detection methods: R-CQ and KAMY efficiently identify Y chromosome sequences in Tephritidae insect pests. In BioRxiv. Zenodo. <https://doi.org/10.1101/2023.10.27.564325>

Scolari, F. (2024). Metabolic Profiling of Tephritid Organs: A Novel Approach For Evaluating Male Quality Markers. 5th Meeting of Tephritid Workers of Europe, Africa and the Middle East (TEAM) (TEAM), Belle Mare, Mauritius. Zenodo. <https://doi.org/10.5281/zenodo.11208599>



Find all scientific publications of REACT on **Zenodo**:
<https://zenodo.org/communities/react-insect>



PROF. DR. MARC F. SCHETELIG PROJECT COORDINATOR

✉ marc.schetelig@agrar.uni-giessen.de

☎ +49 641 99 35900



▶ www.youtube.com/@react_insect

📷 www.instagram.com/react_insect

🐦 www.inaturalist.org/projects/react-insect

in www.linkedin.com/company/react-insect



🌐 react-insect.eu

Partners



Imperial College
London

iscte
UNIVERSITY
INSTITUTE
OF LISBON



UNIVERSITY OF
PATRAS
ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ



OIKO+



Funded by
the European Union

