

FROM LAB TO ORCHARD



REACT 

REACT and the Future of Sustainable Pest Control in Europe



REACT Aims to Adapt SIT to European Agricultural Systems



Funded by
the European Union



Photo:
The REACT team at the
project's General Assembly
in Parma, September 2025.

IMPRESSUM

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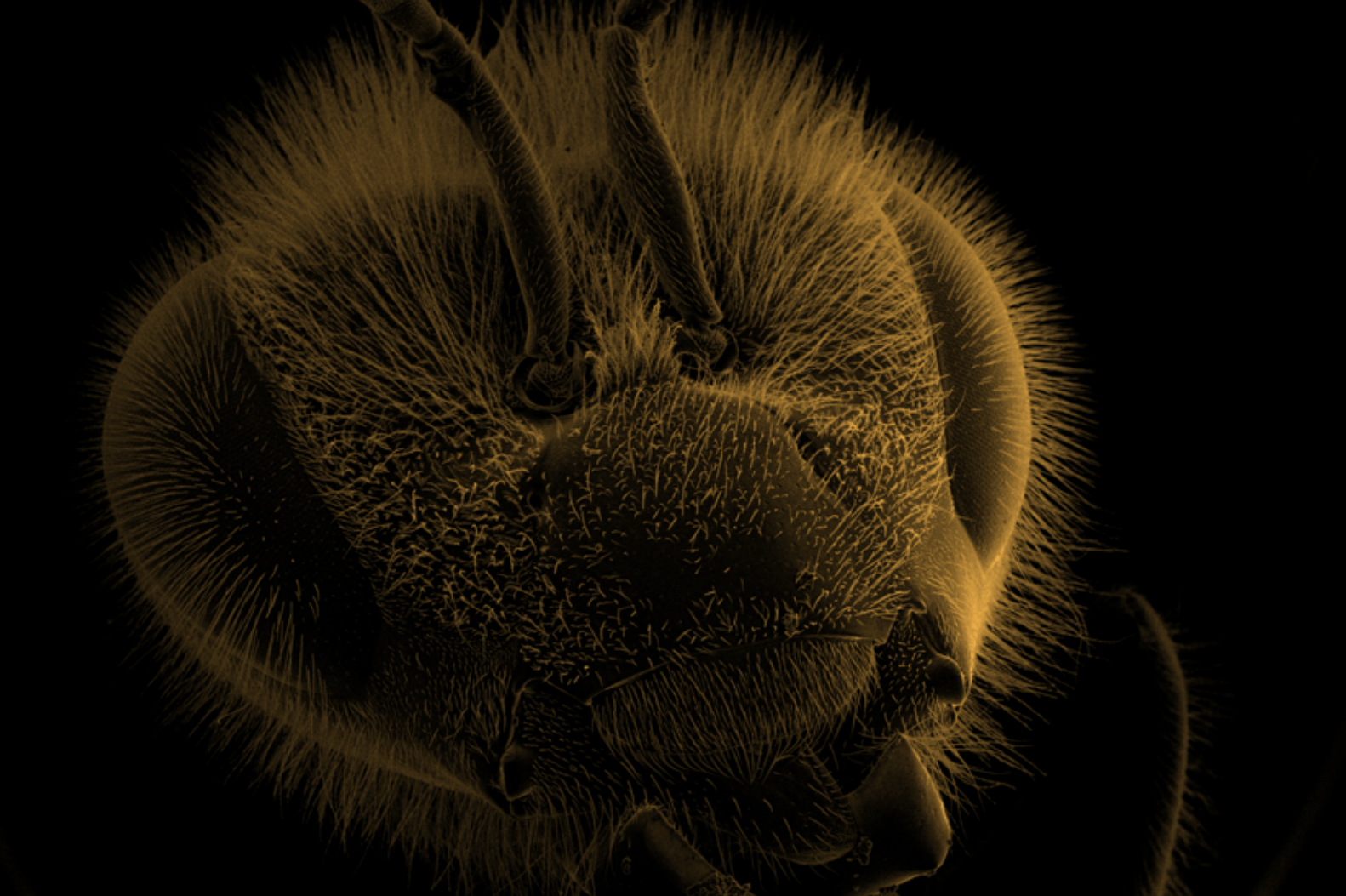
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WHY WE STARTED REACT

When we started REACT, we were driven by the question how Europe responds when invasive fruit flies arrive. This report outlines how sustainable agricultural protection can be achieved.

REACT focuses on two invasive species, *Bactrocera dorsalis* and *Bactrocera zonata*, which pose a growing risk to European fruit production. Our goal is to develop a system that enables rapid, coordinated response. At its core is the Sterile Insect Technique (SIT), a method successfully used worldwide that must be adapted to Europe’s context.

Global trade and climate change are increasing the likelihood that invasive pests reach Europe. Once established, control becomes difficult and costly. REACT offers a biological alternative that is both effective and aligned with Europe’s environmental ambitions.

This report provides an overview of our work and key findings. It explains the challenge of invasive fruit flies, introduces SIT, and shows how REACT combines biology, agronomy and socio-economic analysis to develop solutions for European agriculture. 🌱



Marc F. Schetelig

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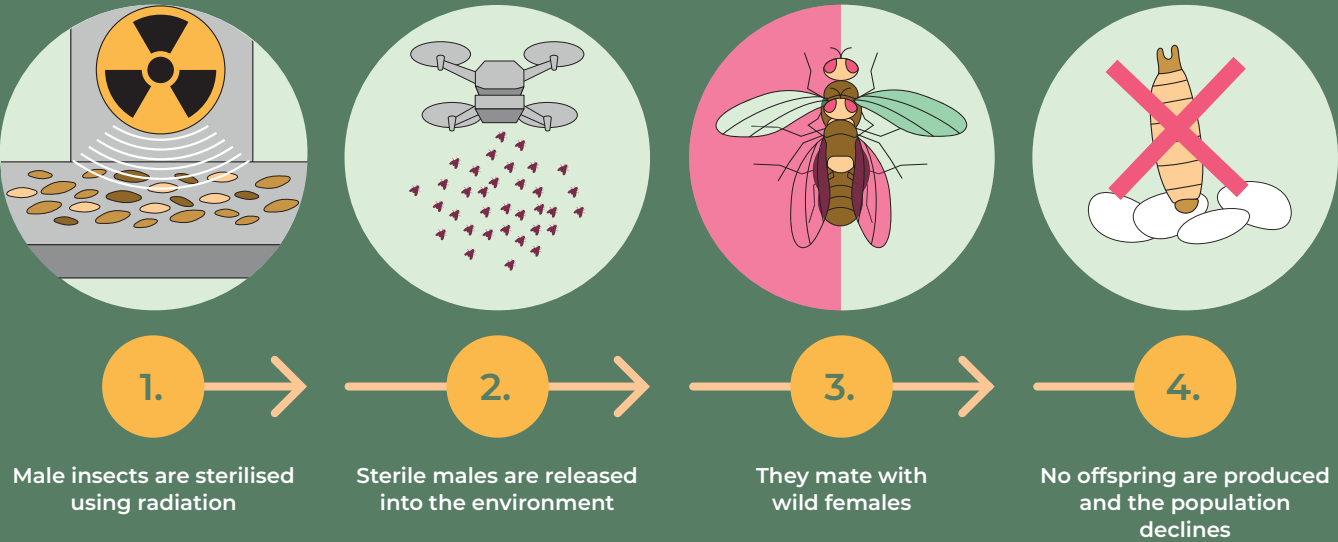
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HOW SIT WORKS

At the heart of REACT lies the Sterile Insect Technique (SIT) — a method that controls pest populations by interrupting their reproductive cycle.

Scientists rear large numbers of the target insect and sterilise the males using precisely

calibrated radiation. These sterile males are then released into the environment, where they compete with wild males for mating. When they mate with wild females, no viable offspring are produced. Over successive generations, the population declines.





1. Introducing REACT

REACT is a European research project developing fast, pesticide-free responses to invasive insect pests — with a particular focus on fruit flies that threaten agriculture, ecosystems, and trade.

At its core, REACT builds on the Sterile Insect Technique (SIT) — a method that suppresses pest populations by releasing sterile males that cannot produce offspring. By combining biology,

genetics, modelling, and field testing, the project turns this proven approach into a rapid-response system tailored to European conditions.

Rather than reacting too late — when pests are already established — REACT focuses on early detection, targeted intervention, and coordinated action. The goal is simple: protect food production, reduce pesticide use, and safeguard biodiversity across Europe.

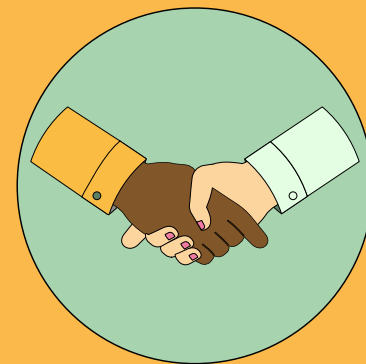
Project Objective

To provide rapid, pesticide-free pest control solutions that protect ecosystems, biodiversity, and European agriculture.



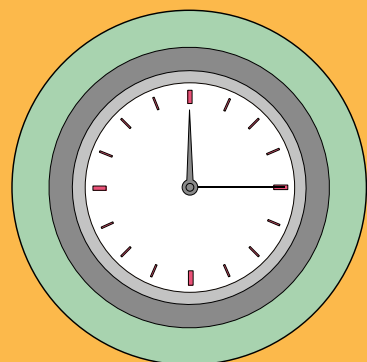
Project Partnership

REACT brings together 15 partners from 12 countries across 3 continents, combining expertise from science, agriculture, and policy.



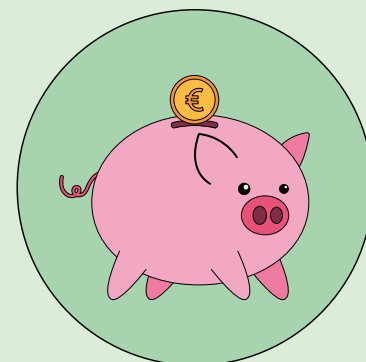
Project Duration

REACT is a 54-month project running from November 2022 to April 2027.



Project Funding

The project is funded with €6.65 million under the EU's Horizon Europe programme.



2. The REACT Approach: Preparing Europe for Invasive Pests

European agriculture faces a growing threat from invasive fruit flies. The REACT project develops a SIT-based, pesticide-free rapid-response system for local invasion scenarios adapted to Europe's ecological, regulatory and economic conditions.

Among the most threatening pests for Europe are two invasive fruit fly species: the Oriental Fruit Fly (*Bactrocera dorsalis*) and the Peach Fruit Fly (*Bactrocera zonata*). Both species have expanded from their original range in Asia into Africa and parts of the Mediterranean region. Their broad host range includes citrus, peaches, figs and many other fruits of high economic importance to the European Union. Even limited outbreaks can disrupt trade within weeks and impose severe costs on growers and exporters. Preventing establishment is therefore far more effective than attempting eradication after a species has spread.

The REACT project responds to this challenge by adapting the Sterile Insect Technique (SIT) to European ecological and regulatory conditions. SIT suppresses pest populations through the release of sterilised males that mate with wild females, resulting in no viable offspring. The method is species-specific, leaves no chemical residues and does not affect non-target organisms. It offers a pesticide-free tool that aligns with European sustainability objectives.

REACT is structured into interconnected work packages that together form a comprehensive rapid-response framework. The project begins with detailed biological and ecological research on *Bactrocera dorsalis* and *Bactrocera zonata* to understand their invasion dynamics, climatic limits and seasonal behaviour in European environments (WP1). This knowledge underpins the optimisation of mass-rearing systems and sterilisation protocols to ensure that sterile males are both fully infertile and competitive under field conditions (WP2).

Rapid molecular detection tools are created to allow early and reliable species identification (WP3). In parallel, advanced genetic sexing systems are developed to enable efficient male-only releases, increasing operational effectiveness and reducing costs (WP4).

Field validation trials under realistic European farming conditions test the operational feasibility of the approach and integrate monitoring systems with predictive release strategies. Digital modelling supports decision-making by simulating invasion scenarios and guiding intervention timing and scale (WP5). In parallel, socio-economic and governance analyses evaluate cost-effectiveness, regulatory integration and stakeholder acceptance to ensure that the system is not only biologically sound but also economically and institutionally viable (WP6). Communication and dissemination activities translate scientific results into policy-relevant guidance and support dialogue with farmers, authorities and the broader public (WP7).

Rather than introducing an entirely new concept, REACT refines and contextualises a method with decades of global operational experience. Its objective is preparedness: to provide Europe with a scientifically robust, environmentally responsible and economically viable system that can be activated quickly to contain *Bactrocera dorsalis* and *Bactrocera zonata* at the earliest stage of incursion.

A courgette showing damage following the egg laying of fruit flies, photographed in Mauritius, 2024.




Massimiliano Virgilio

Taxonomist
Royal Museum for
Central Africa, Belgium

"The Oriental Fruit Fly has been detected in Belgium, far north of its range. We are assessing whether this is temporary or a sign of establishment, as warming aids its survival through European winters."



3. The Challenge

Fruit flies are among the most economically damaging agricultural pests worldwide. By laying eggs inside ripening fruit, they render produce unmarketable — and even a single infested shipment can lead to immediate trade restrictions.

Two invasive species are of particular concern for Europe: the Oriental Fruit Fly (*Bactrocera dorsalis*) and the Peach Fruit Fly (*Bactrocera zonata*). Both originate from Asia and have expanded rapidly across Africa and parts of the Mediterranean. Their wide host range — including citrus, peaches, figs, and many other fruits — makes them highly adaptable and difficult to control.

The risk is increasing. Global trade enables accidental introductions through imported goods, while rising temperatures make European regions more suitable for these species. Once established, eradication becomes complex and costly, often requiring intensive chemical control. Europe's agricultural landscape adds another layer of difficulty. Fruit production is typically organised in small, fragmented orchards embedded in diverse environments. While this supports biodiversity, it complicates coordinated pest control and limits the feasibility of large-scale interventions.

Taken together, this creates a clear challenge: responding early enough to prevent outbreaks from becoming established. Once an invasive fruit fly spreads, control options narrow quickly and impacts escalate. REACT is designed to act before that point is reached.

HOW DO INVASIVE SPECIES SPREAD?

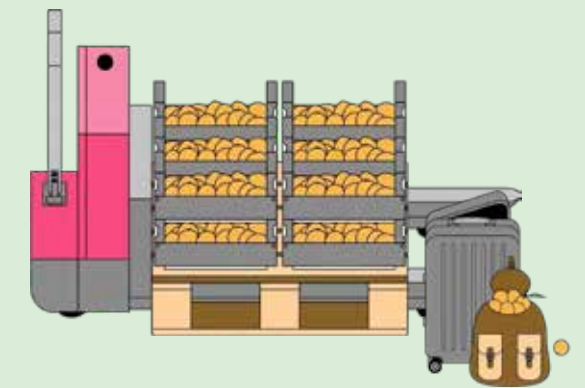
1.

Fruit flies spread in various ways. For example, in travelers' luggage or undetected in imported fruits and vegetables.



2.

Control measures must be constantly adapted to new pests. And yet, it remains difficult to prevent the widespread introduction of invasive species.



WHY SIT MATTERS

Invasive fruit flies are not just an agricultural problem — they affect everyone who relies on stable food systems. Capable of infesting hundreds of fruit types and crops, they cause billions in global losses each year.



FOOD SECURITY:

When pests spread, harvests decline. This can reduce the availability of fruits and vegetables and increase prices for everyday food products.



LESS PESTICIDE USE:

Pest outbreaks are often controlled with chemical spraying. SIT offers a pesticide-free alternative for safer food and healthier environments.



BIODIVERSITY PROTECTION:

Unlike pesticides, SIT targets only one species. Pollinators like bees and other beneficial insects remain unharmed.

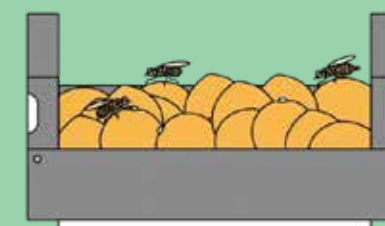


STABLE TRADE AND ECONOMIES:

Even a single detected pest can stop exports. Preventing outbreaks protects jobs, regional economies, and food supply chains.

3.

Logistics hubs in the fruit and vegetable trade often play a key role in the spread of invasive species. Ports and airports are therefore the focus of inspections.



4. Fast Field Detection of Fruit Fly Larvae

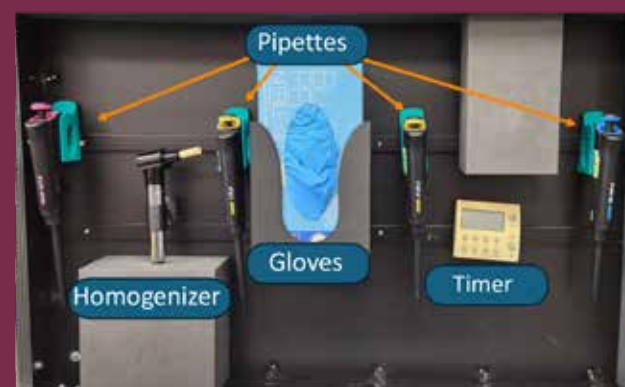
REACT has developed a portable, CRISPR-based identification kit that delivers species-level results on-site — without laboratory infrastructure, and with approximately 97% accuracy.

Invasive fruit flies can cause enormous economic damage to agriculture — the earlier they are detected, the better they can be controlled. Until now, methods for identifying fruit fly larvae were often slow, dependent on laboratory equipment, or required specialised expertise that is frequently unavailable at border inspection points and in the field.

As part of the REACT project, a portable Rapid Identification Kit was developed based on CRISPR/Cas12a technology. It enables direct identification of priority fruit fly species —

including *Bactrocera dorsalis*, *Bactrocera zonata* and *Ceratitis capitata* — on-site, without any laboratory infrastructure. The kit combines a simple DNA extraction process with species-specific molecular recognition components and fluorescence-based detection, delivering results within a short time frame. Validation using 100 field samples demonstrated a detection accuracy of approximately 97% compared to DNA barcoding.

The kit is housed in a robust, wheeled carrying case and can be operated using standard cooling boxes. It supports authorities and practitioners in rapidly distinguishing high-risk invasive species from harmless fruit flies — enabling timely and targeted action in surveillance, border control and outbreak response. 🦟



5. Genetic Methods and CRISPR: Inside REACT

To make the Sterile Insect Technique more precise and cost-effective, REACT researchers are engineering genetic tools that allow male and female insects to be separated before they emerge.

One of the most technically ambitious strands of the REACT project takes place in labs at Imperial College London, Justus-Liebig-University Gießen and the Hebrew University of Jerusalem, where researchers are using cutting-edge genetic tools to develop smarter, more targeted approaches to fruit fly control. At the heart of this work is CRISPR-Cas9 technology, which allows scientists to precisely edit insect genomes and integrate specific markers into the Y chromosome of the Mediterranean fruit fly (*Ceratitis capitata*) and perspective also to *Bactrocera dorsalis* — enabling the reliable identification and release of males only, as required for SIT.

The goal is to create Genetic Sexing Strains (GSS) — lines of insects in which males and females can be reliably distinguished before they emerge. This is beneficial for the efficacy of SIT. By separating the sexes early, the process becomes significantly more efficient and avoids the accidental release of females, which are the actual crop pests.

Because the primary target species of REACT — *Bactrocera dorsalis* and *Bactrocera zonata* — are classified as quarantine pests and cannot be handled freely in European laboratories, the medfly serves as a proxy. Genetic tools developed and validated in the medfly can subsequently be transferred to the target species by project partners working under appropriate biosafety conditions.

Beyond their immediate application, these methods point towards a longer-term vision of pest control that is species-specific, non-toxic, and environmentally sustainable — reducing the need for conventional pesticides and aligning with the EU's broader goals for greener agriculture. 🦟



Angela Meccariello

Molecular Biologist
Imperial College
London, UK

"Our work 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, or functional genes that create a sex-linked phenotype — for instance, pupae that change colour depending on sex. 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."

IMPERIAL

6. Sterile Insect Technique: Principle and Practice

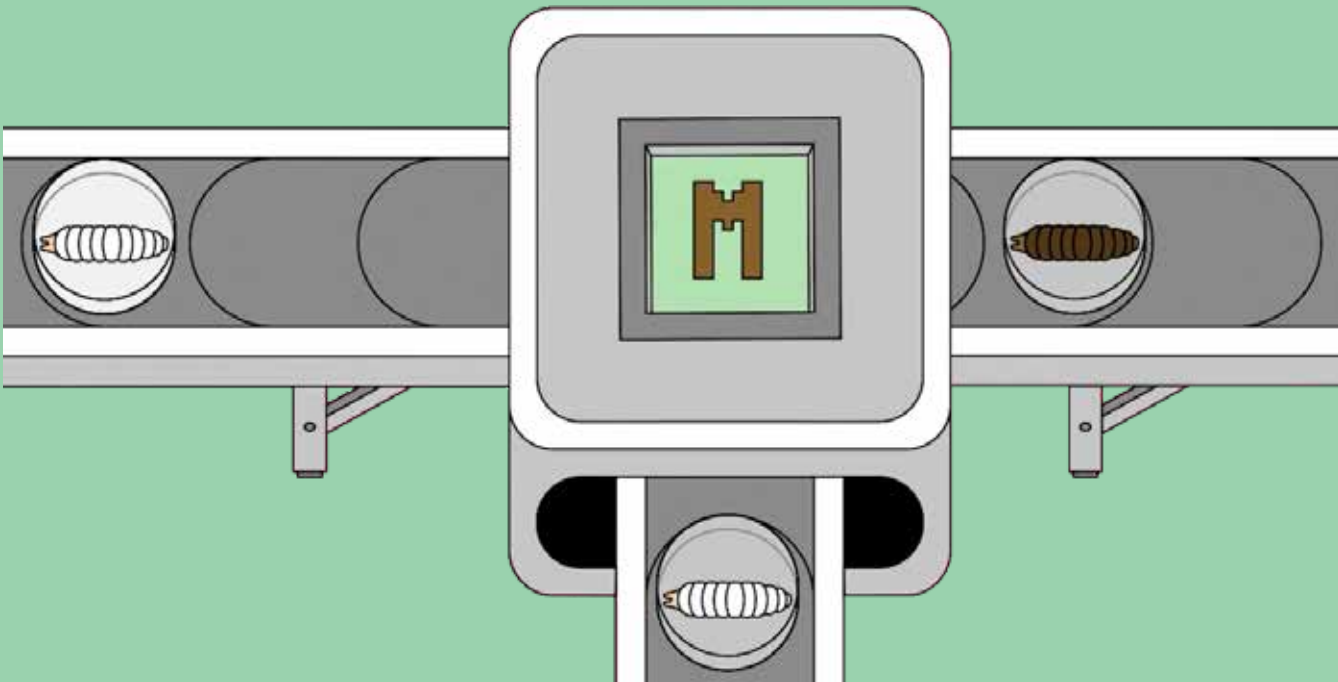
The Sterile Insect Technique takes a fundamentally different approach to pest control. Rather than killing insects with chemicals, it uses their own reproductive biology against them — suppressing populations without residues, resistance or harm to other species.

The process begins with the mass rearing of the target species in specialised facilities. Male insects are then sterilised through precisely controlled irradiation. This irradiation affects the reproductive cells but does not impair the insects’ ability to fly, survive and compete for mates. When released into the environment, sterile males mate with wild females. Because no viable offspring result from these matings, the overall population declines over successive generations.

The power of SIT lies in its species specificity. Only individuals of the target species are affected. Pollinators, predators, soil organisms and other beneficial insects remain untouched. There are no chemical residues in fruit, soil or water. Unlike broad-spectrum insecticides, SIT does not induce resistance, as it does not rely on toxic pressure but on reproductive disruption.

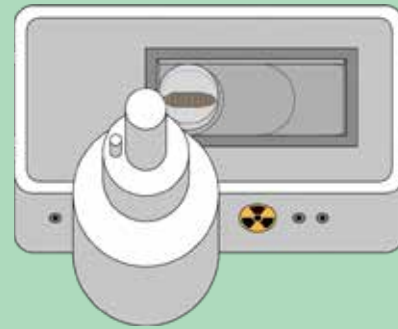
The technique has a long operational history. It was first successfully applied in the 1950s to eradicate the New World screwworm from parts of the United States and later from large regions of Central America.

1. Separation of male and female pupae in the laboratory. Through the use of genetic sexing strains, this can be done by machine-based color detection and sorting, or by heat-shock-based removal of females.

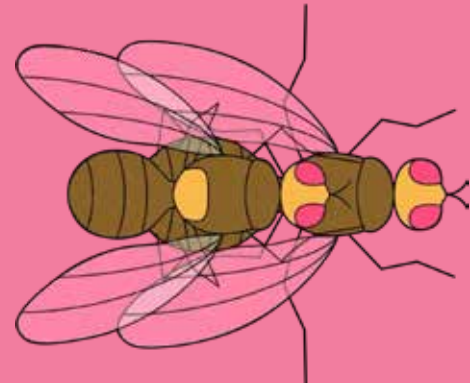


Fruit fly pupae in the quality control lab at the Tragsa rearing facility in Valencia, Spain.

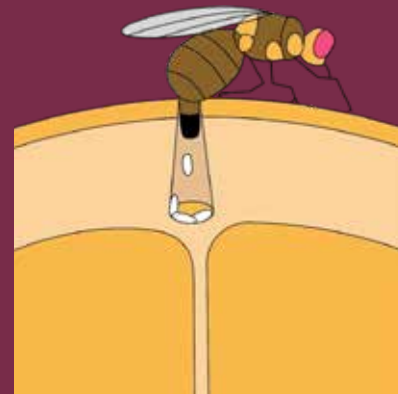
2. The pupae are sterilized by precisely measured dosage of gamma- or x-ray.



3. The sterilized adult male flies get released in pest-infested areas, where they mate with the wild females.



4. The mating produces eggs, but without offspring. And over time, the pest population declines.



5. Reducing pest populations means no eggs or larvae in the fruit, improving food quality and safety.

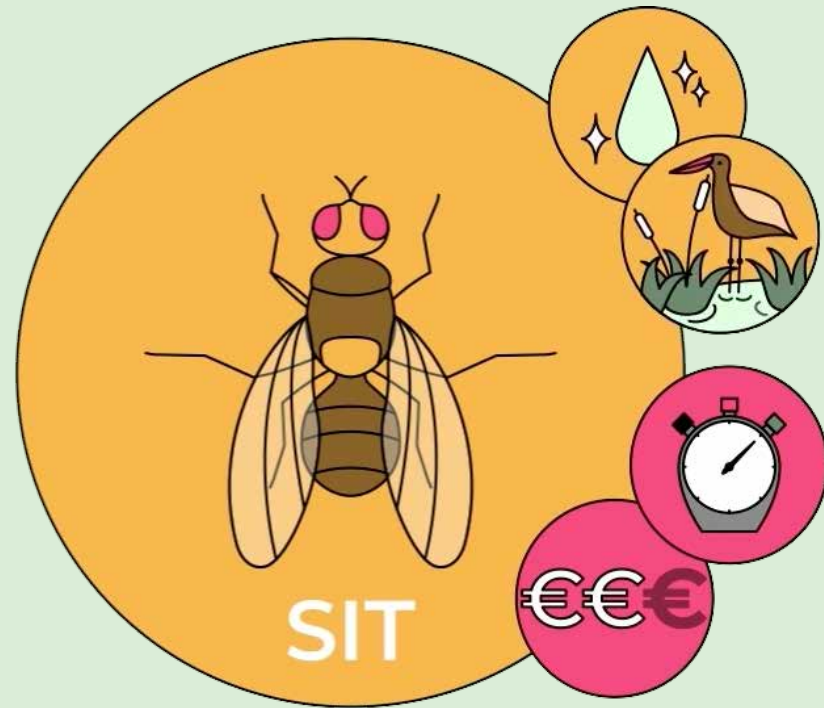


Since then, SIT has been used against various fruit flies, Tsetse flies and moth species across multiple continents. International organisations such as the FAO and the IAEA have developed quality-control standards and supported implementation worldwide.

Importantly, SIT is self-limiting. Sterile insects do not establish new populations. Once releases cease, the intervention naturally ends. This characteristic distinguishes SIT from other biological or chemical interventions that may have persistent ecological effects.



Sterilized male fruit flies are loaded to a release plane in Valencia, Spain.



7. Advancing SIT for European Conditions: The REACT Approach

Adapting the Sterile Insect Technique to Europe requires more than transplanting existing programmes. REACT combines early detection, refined sterilisation protocols, genetic sexing and digital modelling into a coherent system designed for Europe's fragmented agricultural landscapes.

A core component of REACT is early detection. Rapid identification of invasive fruit flies is essential for containment. The project develops portable molecular detection tools that enable species identification with high precision. Early confirmation allows authorities to intervene before populations become established and widely dispersed.

Operational efficiency is another focus. Traditional SIT programmes often rear and sterilise both male and female insects, even though only males are required for population suppression. REACT refines genetic sexing approaches that allow early separation of males and females during the rearing process. By producing male-only cohorts for release, the technique becomes more efficient, cost-effective and logistically streamlined.

Sterilisation protocols are also optimised. The irradiation dose must achieve full sterility while

preserving insect fitness and mating competitiveness. REACT evaluates dose-response relationships to ensure that sterile males perform effectively in the field. In parallel, the project explores the use of modern X-ray systems as alternatives to traditional gamma sources, potentially simplifying regulatory procedures and reducing infrastructure constraints.

Digital modelling constitutes another innovation layer. Computer simulations integrate ecological data, climatic variables and landscape structure to predict how invasive fruit flies might spread. These models support evidence-based decision-making by estimating required release densities, optimal timing and expected suppression outcomes. Modelling transforms SIT from a purely operational tool into a predictive and strategic instrument.

Finally, REACT integrates socio-economic assessment into its scientific framework. The adoption of SIT depends not only on biological feasibility but also on economic viability. Through stakeholder consultations and cost-benefit analyses, the project evaluates whether SIT can compete with or complement existing pest-control strategies within different European farming systems.

8. Field Validation in Greece

Laboratory results must prove themselves under real farming conditions. REACT conducts pilot trials in the Naoussa Valley in Central Macedonia — a region of small, fragmented orchards that reflects the complexity of European fruit production.

The region is characterised by small orchards and diverse crop systems, reflecting the fragmented structure typical of European fruit production. The Mediterranean fruit fly is used as a proxy species for testing operational parameters under controlled conditions.

The trials combine intensive trapping, ecological monitoring and climate data collection with predictive modelling. This approach allows researchers to simulate outbreak scenarios and evaluate how SIT could be deployed effectively in fragmented European landscapes.



In the fertile Naoussa Valley region in Northern Greece, the local SIT application is tested using medfly in orchards.





Nikos Papadopoulos

Entomologist
University of Thessaly,
Greece

„SIT has proven itself world-wide – but on large areas. Europe works differently: small-scale, fragmented, complex. Fifty percent of farms are smaller than two hectares. That is what makes area-wide control the real challenge – and the real task: we need decentralised production capacities that can respond to invasive outbreaks.“



9. Infrastructure and Cooperation: Scaling SIT in Europe

Scaling up the Sterile Insect Technique (SIT) across Europe requires an understanding of European agricultural systems and the ability to integrate SIT into them.

Traditional SIT programmes were historically designed for large, continuous agricultural zones and relied on centralised, state-supported infrastructure. In countries such as Mexico or the United States, vast monocultures allow area-wide releases coordinated by national authorities. In such systems, a single high-capacity mass-rearing facility can supply millions of sterile insects for uniform landscapes, and long-term public funding ensure operational stability. The organisational logic was hierarchical and territorially expansive.

Europe presents a fundamentally different context. Fruit production is typically fragmented across small and medium-sized orchards embedded in heterogeneous landscapes that include villages, forests and mixed crops. Jurisdictional responsibilities are distributed across member states, and plant-health competences often intersect with regional authorities, national ministries and EU-level regulation. In this environment, a purely centralised, top-down SIT infrastructure would face logistical, financial and political constraints.

REACT therefore examines how SIT can be embedded within a distributed governance model. Instead of relying exclusively on one large national facility, the project explores the feasibility of regional rearing units capable of serving clusters of orchards across defined risk zones. Such units could operate under harmonised EU quality standards while remaining geographically close to outbreak areas, reducing transport times and increasing responsiveness. Modular infrastructure concepts also allow scaling up or down depending on outbreak size, which is critical for rapid-response scenarios.

Equally important is the economic organisation of implementation. In most EU member states, fruit production is privately managed and market-driven. Growers operate under tight margins and require predictable cost structures. REACT therefore analyses cooperative financing mechanisms in which producer organisations, regional plant-protection authorities and, where appropriate, EU funding instruments share operational costs. Models inspired by existing agricultural cooperatives – such as those in wine consortia, irrigation associations or integrated pest-management

groups – demonstrate that collective action can reduce individual burdens while maintaining high standards of quality control and traceability. At the same time: regional area-wide approaches could also work for European suppression projects.

The integration of SIT into European plant-health governance also requires regulatory clarity. Releases of sterile insects must align with EU Plant Health Regulation, radiation-safety frameworks and cross-border notification procedures. REACT evaluates how harmonised protocols and shared data platforms could enable coordinated action between neighbouring Member States, particularly in border regions where invasive species do not respect administrative boundaries. In this sense, SIT becomes part of a broader biosecurity architecture rather than a stand-alone technical measure.

The conceptual shift is therefore not merely technical but institutional. SIT in Europe cannot function solely as a large-scale eradication campaign deployed after widespread establishment. It must become a component of routine preparedness: a tool that can be activated early, scaled proportionally and embedded within integrated pest-management systems already used by growers. By linking biological innovation with cooperative governance and regulatory integration, REACT reframes SIT from an emergency intervention into a structured element of European agricultural resilience. 🌱



Francesca Scolari

Molecular Biologist
Consiglio Nazionale delle Ricerche,
Italy

„As a biologist studying insect reproduction, I've seen REACT's science deepen our understanding of the molecular and symbiotic mechanisms that shape insect fitness and behaviour—opening new pathways for more targeted and sustainable pest control strategies.“



10. Protecting Biodiversity

Every pest-control method involves trade-offs. The Sterile Insect Technique minimises them: species-specific, residue-free and compatible with organic farming, it aligns closely with Europe's Farm to Fork Strategy and Biodiversity Strategy 2030.

Every pest-control method involves trade-offs. Chemical pesticides, while effective in the short term, often carry ecological costs, including impacts on pollinators, aquatic organisms and soil health. They may also contribute to the development of resistance in target species. SIT minimises these trade-offs.

By targeting only the pest species and leaving other organisms unaffected, it preserves ecological balance. The absence of chemical residues aligns the method with European sustainability objectives under the Farm to Fork Strategy and the Biodiversity Strategy 2030.

Moreover, SIT is compatible with organic farming and low-input agricultural systems. By reducing reliance on chemical interventions, it contributes to safer working conditions for farmworkers and reduced environmental contamination. 🌱



Aruna Manrakhan

Entomologist
Citrus Research International, South Africa

“Regarding the acceptance of the SIT technology, stakeholders expressed that they are willing to consider the SIT technology but only if it is cheaper or the same as the current control method. If SIT is affordable, stakeholders will embrace it.”



11. Governance, Safety and Public Engagement

Public perception plays a crucial role in the implementation of innovative pest-control methods. That’s why REACT also focuses on whether SIT is practical, affordable, and publicly acceptable.

Concerns often arise around the use of radiation or genetic techniques, particularly in contexts where terms such as “irradiation” or “genetics” may evoke associations with nuclear risk or genetic modification. Addressing these concerns requires clarity and factual transparency.

In contemporary SIT programmes, sterilisation is typically achieved using high-energy X-ray systems rather than radioactive sources. X-ray irradiation delivers a precisely calibrated dose of ionising radiation to insect pupae, inducing controlled damage in reproductive cells while leaving the insects otherwise biologically functional. The radiation does not remain in the flies’ bodies, and no radioactive material is released into the environment. Sterilised males emerge, disperse and compete for mates, but they cannot produce viable offspring. Importantly, no new genetic material is introduced into wild populations, and sterile insects cannot establish or persist beyond the release period.

Beyond technical safety, economic viability is equally decisive. REACT therefore integrates a structured cost-benefit analysis within its socio-economic work package. This analysis compares SIT with existing control strategies, taking into account direct operational costs, avoided pesticide applications, reduced crop losses and potential gains from maintaining export markets. Scenarios are evaluated for different farm sizes and production systems, including fragmented orchard landscapes typical of southern Europe. The objective is not only to demonstrate biological effectiveness but also to determine under which conditions SIT becomes economically rational for growers and plant-protection authorities.

Stakeholder engagement accompanies this analytical work. Farmers, producer organisations, regulatory authorities and supply-chain actors are consulted to assess practical feasibility, regulatory alignment and willingness to adopt the technology. Monitoring systems and quality-control protocols ensure traceability of sterile male production and release, reinforcing institutional credibility.

SIT is therefore positioned neither as a technological experiment nor as a universal substitute for all pest-control measures. Rather, it is developed as a targeted, scientifically validated and economically assessed complement within integrated pest-management strategies. Its legitimacy rests on three pillars: biological precision, regulatory compliance and demonstrable cost-effectiveness. 🌿



12. Communicating REACT

From the outset, REACT has placed strong emphasis on communication, explanation and stakeholder engagement. It is not an add-on, but a condition for success.

The Sterile Insect Technique is effective, but not self-explanatory. Concepts such as irradiation, insect mass-rearing and genetic sorting require careful explanation to be understood and accepted beyond expert communities.

Our audiences are diverse: farmers, policymakers, plant-health authorities, researchers and the broader public. Each brings different expectations, knowledge and concerns. A central challenge was translation – communicating a technically complex method in a way that is accurate, accessible and credible, without oversimplifying or creating misunderstandings.

A second challenge was trust. Terms like “radiation” or “genetics” can trigger scepticism if not properly contextualised. We addressed this through transparency and by explaining processes in concrete, observable terms – showing how SIT works in practice, from rearing and sterilisation to field release. This grounded the technology in reality. Video has been central to this strategy. It visualises processes and makes abstract steps tangible. Filming in operational environments adds authenticity, demonstrating that SIT is a working system. Videos also allow flexible use across platforms, from workshops to social media and policy communication.

Throughout the project, these formats were combined with continuous stakeholder engagement. Workshops, site visits and exchanges ensured communication was not one-directional. Feedback from growers and authorities shaped how we framed messages and clarified key questions.

Communication in REACT is therefore not just dissemination. It is part of the project’s infrastructure – connecting scientific development with real-world application and ensuring solutions are understood, accepted and usable in practice. 🌿

Science communication is a key objective of REACT, aimed at making research accessible and understandable. That is why cameras follow the researchers across Europe, to South Africa, La Réunion, and Mauritius.



Thomas Stollenwerk

Science Communicator
Oikoplus GmbH, Vienna, Austria

„Ambitious research projects like REACT generate knowledge — but knowledge alone does not necessarily open doors. Technical readiness gets a technology to the threshold; societal readiness determines whether anyone walks through it. Science communication is how innovations earn their place in the world.“

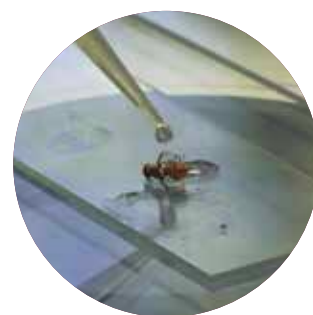
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Communication for
Research & Innovation

13. Strategic Importance for Europe

Climate change and globalised trade are making biological invasions more likely, more frequent and harder to reverse. Europe needs tools that are ready before the next outbreak — not developed in response to it.

Global trade and climate change increase the probability of biological invasions. Traditional reactive approaches based on chemical suppression are increasingly constrained by environmental regulation and public expectations. REACT provides a preparedness framework. By combining biological precision, predictive modelling and economic analysis, the project develops a toolset that can be activated rapidly when invasive fruit flies are detected. The benefits extend beyond immediate pest control. Strengthened food security, improved export reliability and reduced chemical dependency contribute to broader resilience within European agricultural systems. 🌿



A fruit fly under the microscope at the CIRAD Lab in Saint Pierre, La Réunion.

REACT ACHIEVEMENTS

REACT has developed and tested key components of a European rapid-response system for invasive fruit flies—combining laboratory research, field validation, and operational tools:



Rapid Identification Kit

A portable, CRISPR-based tool that enables on-site detection of fruit fly larvae with 97% accuracy, allowing faster and more targeted responses

Sex-selective breeding approaches

Improved breeding systems that make it possible to release only sterile males, increasing efficiency and reducing costs

Improved rearing and release systems

Including microbiome optimisation to enhance insect performance and drone-based distribution for precise coverage

Field trials in Greece

Real-world testing of SIT in fragmented European orchard landscapes, generating data on feasibility, timing, and effectiveness

Modelling tools

Digital simulations that predict pest spread and help determine when, where, and how many sterile insects need to be released

Stakeholder engagement

Continuous collaboration with farmers, regulators, and researchers to ensure practical applicability and acceptance

Together, these elements form the basis of a scalable, European SIT response system—designed to act early, operate locally, and reduce reliance on pesticides. 🌿

14. From Research to Readiness

Looking ahead, the results of REACT extend beyond the project itself and point towards future implementation. They mark an important step in shaping a more coordinated and sustainable approach to pest control in Europe.

REACT demonstrates how a proven method such as the Sterile Insect Technique can be adapted to Europe's specific agricultural, ecological, and regulatory conditions.

By combining advances in biology, genetics, modelling, and field validation with close stakeholder engagement, the project establishes the foundations for a more precise, sustainable, and coordinated approach to pest control.

At the same time, REACT is not an endpoint, but a transition towards operational readiness. The work carried out within the project now opens the way for further validation under diverse European conditions, ensuring that SIT can be reliably deployed across different climates, crops, and farming structures. Building on these results, the next step is to translate scientific knowledge into practical implementation—developing guidelines for local rearing, release strategies, and monitoring systems.

Ongoing research will continue to refine key technologies, including genetic sexing strains

and rapid detection tools, with the aim of increasing efficiency while reducing operational costs. In parallel, integrating these tools into existing policy and governance frameworks will be essential. Supporting national plant protection organisations with data, protocols, and decision-making tools will allow for faster, more coordinated responses across borders.

The long-term perspective is one of preparedness. Rather than reacting to large-scale outbreaks, Europe can move towards a system that detects and contains invasive pests at an early stage—before they become established. In this context, REACT contributes to a shift in how pest control is approached: from reactive intervention to proactive, science-based management that protects agriculture, food systems and biodiversity without relying on large-scale pesticide use. 🌿



Close contact with farmers

Marc Schetelig during a field visit in the Naoussa Valley region in Central Macedonia, Greece, where the SIT approach is verified under real-life farming conditions.



10TH IOBC-WPRS WORKING GROUP MEETING

on Modern Biotechnology in
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STAY CONNECTED WITH REACT

The REACT project shares its latest findings, field insights, and science communication materials through its YouTube channel and project website. Watch interviews with researchers, explore how the Sterile Insect Technique works in practice, and follow the project's progress across Europe.



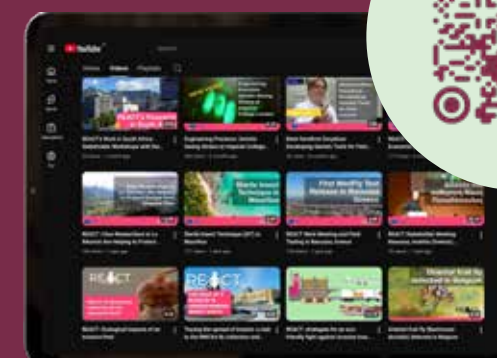
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