PHERA project brings eco-friendly pest solutions to field crops

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DISSEMINATION
PHERA Project

The PHERA project has successfully advanced the use of pheromones in field crops, marking a significant breakthrough in agricultural pest management. Three years of intensive work in both the lab and the field have resulted in several innovative pheromone products and application methods, representing a major step toward more sustainable farming practices.

When the PHERA project commenced in 2020, the consortium counted four commercial pheromone companies, including ISCA (France), Novagrica (Greece), Russell IPM (England) and SEDQ Healthy Crops (Spain). These four companies were well-established in the speciality crop market: high-value crops, typically fruits and vegetables.

The PHERA project set out to extend the use of pheromones to bulk field crops like corn, rice, and soybeans. Pheromones offer growers an environmentally friendly alternative to insecticides, using mating disruption to prevent pests from reproducing, but their relatively high cost and laborious application methods have made them unviable for row crops.

Pheromones are traditionally applied by manually placing and later removing dispensers or puffers in the orchard, vineyard or field. The consortium partners have, therefore, worked diligently to develop more practical application methods. These include new types of solid dispensers encapsulating the pheromone in polymer matrices with superior characteristics in terms of longevity and degradability. Russell IPM has, for instance, developed a biocompatible solid dispenser that lasts up to 150 days. The companies have also worked to develop sprayable pheromone formulations suitable for row crops, utilising various innovative encapsulating techniques or emulsions.

In an ideal world, row crop growers should only have to spray pheromones once at the start of the growing season. A requirement for repeated application would make pheromones more cumbersome to integrate into conventional farming practices. This imposes significant demands on the product formulation because pheromones are volatile compounds. The pheromone must be encapsulated into a carrier that breaks down over time in the field, releasing the pheromone in a continuous and steady manner throughout the growing season. On the other hand, the carrier must be able to withstand rain or irrigation, and there are other concerns to consider, such as biodegradability, toxicity and adherence to plant surfaces. The four companies have, therefore, carried out many laboratory and field tests of potential new pheromone products and application systems.

During the PHERA project's lifespan, the consortium partners have overseen close to 50 field trials (see Table). They have focused on five insect pests, all of them belonging to the lepidopteran family of moths and butterflies, including fall armyworm, cotton bollworm, diamondback moth and striped and yellow rice stem borers. These pests can cause significant losses to crops like corn, rice, soybean, cabbage and other vegetables, which are all vital for food security and economic stability in many regions worldwide. The field trials have taken place across the globe to cover diverse environments and ecosystems in Europe, South America, Asia and Africa.

The results confirm that pheromone-based mating disruption can be used to control insect pests with a high degree of efficacy, in some cases achieving control rates of over 90 per cent, thus reducing crop damage and increasing yields in a sustainable way.

However, the trials also demonstrated that mating disruption requires a customised approach, considering factors such as pest population pressure, field size, shape and topography, microclimatic conditions, etc. For instance, SEDQ demonstrated that stand-alone pheromone solutions can control the striped rice stem borer in areas like the Ebro Delta of Spain, whereas Novagrica's trials in field tomatoes in France confirmed that pheromones cannot stand alone when the pest population pressure is high.

This is why pheromones are often applied together with other control strategies as part of an integrated pest management (IPM) approach. For instance, Russell demonstrated how a multi-pronged approach can control the yellow rice stem borer in Bangladesh, reducing plant damage by about 50 per cent and increasing yield by over 40 per cent. Russell combined mating disruption with a microbial soil treatment product, which recharges the soil, making plants healthier and more resilient, creating a synergistic effect with mating disruption.

Pheromones offer significant benefits in small-scale farming as a safer alternative to chemical pesticides, aligning well with manual farming methods. However,

their implementation can be complex. ISCA found in Tanzania that challenges to area-wide trials stem from the small plot sizes, staggered planting, and limited community organization. Despite this, smallholders appreciated the ease of replacing weekly insecticide sprays with just two pheromone applications per cycle. Though the cost per application may be higher, pheromones reduced crop damage with less pest management effort and cost, boosting yields and farmers' incomes, thus enhancing rural livelihoods.

The many field trials carried out by the PHERA project have confirmed that mating disruption is an effective and sustainable approach to managing insect pests, reducing the reliance on synthetic insecticides, and promoting healthier and more environmentally friendly agricultural practices.

Now, the consortium partners are looking toward the future. While the PHERA project may have ended, the journey towards widespread adoption and further innovation in pheromone-based pest control is just beginning.

New PHERA Products

Figure 1: Drone delivers pheromone

Drone-delivered blobs of pheromone (Novagrica)

GPS-guided drone (Figure 1) fitted with a system of revolving cartridges that drop PheroWax blobs of a biodegradable, flowable polymer matrix containing the pheromone (PheroDrop (patented)). The PheroWax adheres to plants, ensuring constant release of pheromone during the growing season. The system can target different types of insect pests.

Hydrodegradable dispenser for irrigated fields (Novagrica)

Designed to control diamondback moth (*Plutella xylostella*) in cruciferous vegetables. The gradual disintegration of the dispenser (Figure 2) via irrigation ensures continuous release of pheromone. At the end of the growing season, the dispensers are dissolved, and the bamboo sticks they are mounted on will decompose naturally in the soil.

Figure 2: The hydrodegradable dispenser is dissolved at the end of the growing season.

Biodegradable ampoule dispenser (SEDQ)

A passive ampoule dispenser (Figure 3) with pheromone contained in a biodegradable polymer rather than embodied in a polymer, designed to control the striped rice stem borer (*Chilo suppressalis*) in Southern Europe.

Dispensers for large-area crops (Russell IPM)

Dismate YSB and Dismate FAW are extruded solid dispensers designed to control the yellow stem borer (*Scirpophaga incertulas*) in rice and the fall armyworm (*Spodoptera frugiperda*) in corn in Asia and Africa. These dispensers are placed on sticks in the fields at the start of the growing season (Figure 4) and remain effective for up to 150 days.

Pheromone combined with attract-and-kill (ISCA)

A hybrid form of integrated pest management, combining a sprayable pheromone formulation SPLAT® with an attract-and-kill product (NOCTOVI) containing another attractant and an insecticide. The former disrupts the mating of the key pest. The latter suppresses secondary pests such as other moth species. This targeted approach can reduce insecticide use by more than 98 per cent. Products include SPLAT® FAW (*Spodoptera frugiperda*), SPLAT® *Helio* (*Helicoverpa armigera* and *Helicoverpa zea*), and SPLAT® *Plutella* (*Plutella xylostella*).

Figure 3: Pheromones control the striped rice stem borer in Southern Europe.

Figure 4: These dispensers release pheromone for up to 150 days.

Figure 5: Application of pheromone by airplane in Brazil.

Company	Crop	Insect Pest	Application Method	When	Where	Results	Additional Applications
Novagrica	Cotton	Cotton bollworm	Manual application and single UAV-mounted caulking gun (PheroWax)	2021	Greece	Successful	AI deltamethrin once
	Cotton	Cotton bollworm	Single UAV-mounted caulking gun (PheroWax)	2022	Greece	Successful	AI deltamethrin once
	Field tomato	Cotton bollworm	Manual caulking gun	2022	France	Promising - more trials needed	
	Cotton	Cotton bollworm	Multiple UAV-mounted caulking guns (PheroDrop)	2023	Greece	Successful	AI deltamethrin once
	Cabbage	Diamondback moth	Hydrodegradable dispenser	2022, 2023	Greece	Successful	
Russell IPM	Corn	Fall armyworm	Solid polymer dispenser	2022, 2023	India	Successful	
	Corn	Fall armyworm	Solid polymer dispenser	2022, 2023	Cameroon	Successful	Recharge and Lycomax
	Corn	Fall armyworm	Solid polymer dispenser	2023	Zambia	Promising - more trials needed	
	Corn	Fall armyworm	Solid polymer dispenser	2023	Tanzania	Successful	Lycomax Soil Treatment
	Tomato	Cotton bollworm	Solid polymer dispenser	2022	France	Promising - more trials needed	
	Rice	Yellow rice stem borer	Solid polymer dispenser	2022, 2023	India	Successful	Recharge
	Rice	Yellow rice stem borer	Solid polymer dispenser	2022	Bangladesh	Successful	Recharge
	Rice	Yellow rice stem borer	Solid polymer dispenser	2023	Bangladesh	Successful	Lycomax Soil Treatment
	Rice	Yellow rice stem borer	Solid polymer dispenser	2024	Bangladesh	Successful	Lycomax Soil Treatment
	Corn	Fall armyworm	Solid polymer dispenser	2024	India	Successful	Recharge solid dispenser
	Rice	Yellow rice stem borer	Solid polymer dispenser	2024	India	Successful	Recharge solid dispenser
SEDQ	Rice	Striped rice stem borer	Standard dispenser (Chilotec)	2021 (2 trials)	Spain	Promising - more trials needed	
	Rice	Striped rice stem borer	Standard dispenser (Chilotec)	2021 (2 trials)	France	Successful	
	Rice	Striped rice stem borer	Standard dispenser (Chilotec)	2023	Spain	Successful	
	Tomato	Cotton bollworm	Passive dispenser	2022, 2023	Italy	Successful	ALTCOR®
	Tomato	Cotton bollworm	Passive dispenser	2022, 2023	Spain	Successful	
	Tomato	Cotton bollworm	Passive dispenser	2023 (2 trials)	France	Successful	Dipel®
	Tomato	Cotton bollworm	Passive dispenser	2023	Greece	Successful	
	Broccoli	Diamondback moth	Passive dispenser	2023	Spain	Successful	
ISCA	Corn	Fall armyworm	SPLAT®	2023 (2 trials)	Tanzania	Successful	
	Corn	Fall armyworm	SPLAT®	2022	Brazil	Successful	

PROJECT NAME

PHEromones for Row crop Applications (PHERA)

PROJECT SUMMARY

The PHERA project aims to accelerate the global transition to sustainable agriculture by establishing insect pheromones as a viable alternative to insecticides in row crops. The project has scaled up a new, cost-effective method for the mass production of pheromones and has developed application systems for their use in pest control in row crops.

PROJECT PARTNERS

The PHERA project brought together the yeast fermentation know-how of BioPhero (Denmark), now part of FMC Corporation; the pheromone formulation and application expertise of SEDQ (Spain), ISCA (France), Russell IPM (UK) and NovAgrica (Greece); the piloting capabilities of Bioprocess Pilot Facility (the Netherlands); and the life cycle insights of Fraunhofer (Germany).

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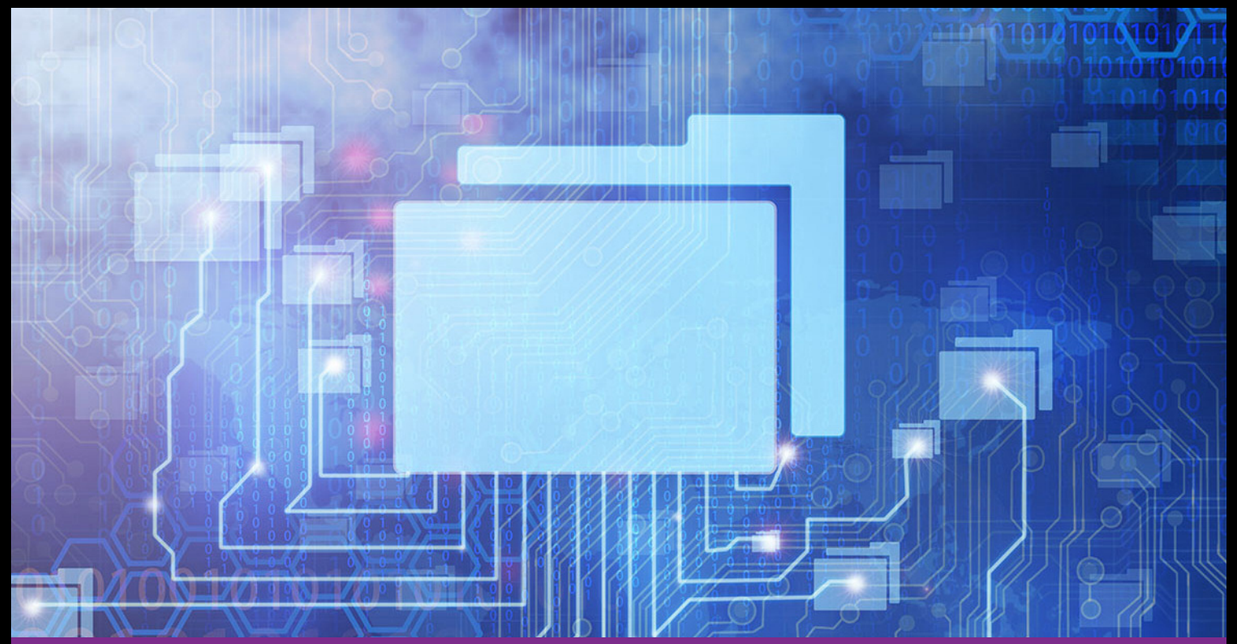

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