Pheromones in fight against pests

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Nowadays, everybody is aware of the toxic effects of the conventional insecticides that are used to protect plants from pest insects. The insecticides are harmful to the farmer who sprays them on the field and for the pollinating insects, e.g., bees; and insecticide residues on fruits and vegetables are harmful to the consumer. But are there any safer ways to protect the plants from pest insects?

One of the most promising methods is mating disruption, where small amounts of insect sex pheromones are released in the field to prevent the males from finding the insect females. This way, females do not get fertilized and cannot lay eggs that develop into larvae eating the plants. The technology is simple and effective, but until now quite expensive.

Through the EU-funded project OLEFINE, scientists from the Novo Nordisk Foundation Center for Biosustainability, DTU, will solve this problem by making pheromones so cheap that they will become an affordable alternative to insecticides. Currently, pheromones are produced by chemical synthesis, which is an expensive and polluting process. Novo Nordisk scientists will use biotechnology instead to produce pheromones at low cost by fermentation, in the same way that insulin is produced for diabetes treatment and enzymes are produced for laundry detergent.

"Pheromones are currently not widely used for protection of lower value row crops, such as corn or soybeans, due to the high cost. We aim to produce pheromones by fermentation, which is potentially a much cheaper route than chemical synthesis, and will make the pheromones

affordable for row crop protection as well," says Senior Researcher at the Novo Nordisk Foundation Center for Biosustainability, DTU, Irina Borodina.

Calls for urgent action

One of the pests that are targeted is the fall armyworm which poses a major threat to food security and agricultural trade. The fall armyworm, so called because it eats its way through most of the vegetation in its way as it marches through crops, is native to North and South America but was identified for the first time in Africa last year.

"African farmers have tried to treat this pest with insecticides, but the pest has become resistant, so there is an urgent need for a solution because otherwise people will starve. The main challenge right now is bringing down the cost of the technology so the farmers can afford to use it. Most of the applications use hand-applied dispensers and that is not really scalable. It is still too expensive," according to Irina Borodina.

Several industrial partners, including BioPhero, Novagrica, ISCA and Biotrend, are now engaged in the OLEFINE project to make pheromones an affordable alternative to insecticides, thus contributing to a more sustainable, low-carbon economy through reduced reliance on petrochemical-based processes.

At the same time, many large insecticide companies are monitoring the current development. New data have revealed that many of the insecticides already on the market are more toxic than anticipated, and just recently the EU agreed that one of the world's most widely used insecticides will be banned from all fields within six months, to protect both wild and domesticated bees that are vital to crop pollination. Additionally, a new study claims that glyphosate, a chemical found in the world's most widely used 'weedkiller' can have disrupting effects on

sexual development, genes, and beneficial gut bacteria at doses considered safe.

According to Irina Borodina, these examples are only the first indicators that prove the need of switching away from using conventional insecticides to protect plants from pest insects.

"Registrations might be withdrawn from many of the insecticides in the upcoming years. Both the companies and the farmers are aware of this. I think the perfect thing about pheromones is that it serves both the farmers' purpose of saving their crops while also contributing to saving the environment. Pollinators, birds and other animals are not directly affected by pheromones and local ecosystems. Thereby it benefits in terms of preserved biodiversity of beneficial organisms," she says.

Bio-pheromones developed as part of the OLEFINE project will replace pesticides in the management of major pests of grapes, soybean and cotton. Research indicates that over 90% of the sprayed insecticides reach a destination other than their target species because they are spread across entire agricultural fields.

Education is crucial

It is absolutely essential that farmers, especially in the third world countries, are educated on how to use pheromones. When the farmers spray the field they are used to seeing the insects, but that is not the case when applying the method of mating disruption.

This is one of the biggest challenges in the transition from conventional insecticides to pheromones. You do not only have to compete on price, people will also need education.

But Irina Borodina stays optimistic.

"My husband keeps buying these ecological products that are really expensive, but I would love if our project could help to make these products available to more people. To succeed in bringing down the cost we just need to be really smart and a little bit lucky with what we do. We have to use all the fantasy and knowledge that we have," she emphasizes.

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