



pheromones for row crop applications

“Recent advances in the production of natural pheromone solutions will bring about a revolution in sustainable insect control.”

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The large-scale adoption of insect pheromones in agriculture holds the promise of a revolution. This article – the first in a new series about bio-pheromones – will highlight key areas of interest and set the scene for in-depth discussions of these areas in subsequent articles.

Ever since the emergence of synthetic pheromones in the late 1960s, their true potential to significantly reduce pest populations has remained unfulfilled in row crops due to their complexity and cost of production. The allurement of immediate curative control offered by cheaper synthetic chemical insecticides has hitherto marginalised pheromones to monitoring and control opportunities in higher-value crop segments.

Increased focus on reducing pesticide usage

Today, however, significant environmental and societal concerns regarding the high consumption of chemical pesticides have driven an unprecedented backlash against the use of conventional plant protection products (PPPs). Initiatives like the EU’s Green Deal, the Farm to Fork and the Biodiversity Strategies envision significant reductions in chemical PPPs. In 2020, the EU Commission proposed a 50% reduction in the use of pesticides by 2030, while France became the first EU country to target a halving as soon as 2025.

Beyond the immediate environmental and human health challenges forced upon us by decades of

usage of chemical PPPs, time has also demonstrated that pests evolve biologically and adapt behaviourally. Despite billions of Euros spent annually on developing newer and ever more selective synthetic pesticides, nature continues to adapt accordingly. As a result, pest resistance is increasing, with many classes of conventional PPPs no longer providing viable control options.

The solution promoted by the chemical crop protection industry to save crop yield and maximise farmer profit has been to push a strategy of applying more chemical per acre – more volume and more mixtures. Consequently, global pesticide application has steadily increased from 2.3 million tonnes in 1990 to 4.1 million tonnes in 2018, according to the Food and Agriculture Organization, indicating a seemingly unsustainable development.

Even cost-effective in low-margin row crops

With the advances in the use of precision fermentation, it is now possible to have yeast cells produce a wide variety of nature-identical insect pheromones at significantly reduced cost. By utilising this fermentation technology, pheromone products offer application costs per acre that now make them a viable control option for even the most price-sensitive row crops. It would appear a turning point has been realised, with options for broader applications of bio-pheromones just around the corner, signalling an impending fall from grace for certain applications of conventional synthetic chemical insecticides.

Imagine all the possibilities that will become available to farmers as mating disruption and attractant technology is put to use in a number of diverse situations. The use of pheromones for pest monitoring and control promises to become an ever more important component of the ongoing challenge to develop alternatives to synthetic chemical pesticides in order to solve their associated environmental and human health problems.

Pheromones can now be considered for safe pest control across multiple product categories in agriculture, large-scale vector control, horticulture, industrial applications and even large-scale government spraying programmes. Their use in expanded urban pest control, professional and consumer indoor applications, homes, office buildings, warehouses, factories, food processing plants, etc. clearly constitutes safer alternatives to synthetic chemical pesticide spraying.



Advances in precision fermentation enables non-toxic control of voracious pests such as the fall armyworm that is ravaging food crops in Africa, Asia and the Near East

Future combinations with other biological agents

Bio-pheromones can be used for stand-alone control solutions, as part of Integrated Pest Management (IPM) programmes or in combination with chemical PPPs to reduce the total chemical consumption or overcome resistance challenges. Growing interest in the use of other categories of biological crop protection agents, such as microorganisms (bacteria and fungi), macroorganisms, plant extracts, RNAi, macrobiologicals, plant viruses, etc., bodes well for

combinations with the now more economically viable bio-pheromone solutions, in order to bring about even further improvements in crop protection products and programmes; approaching, equalling and in some cases surpassing the efficacy of chemical PPPs.

Bio-pheromones' long-term benefits in reducing chemical PPP consumption and resistance, as well as delaying the onset of resistance to genetically modified (GM) crops, both expressing *Bacillus thuringiensis* (Bt) insect protection and other GM traits, will bring about significant improvements in the environment and biodiversity.

Formulation advances increase opportunities

Advances in formulation technologies have pushed pheromones beyond simple bait formulations or waxy strips used to trap or monitor insects. Today, they can be easily applied in row crops, using conventional sprayers, either as advanced, water-based, sprayable liquids, or as oils, pastes, gels, granules, etc. Pheromone formulations now display adjustable, controlled release properties.

Shelf life of pheromone formulations have also been extended, utilising a number of known antioxidants, chelators, stabilisers and encapsulation systems to allow use under normal handling conditions.

Looking to a digital future

Digital technologies are playing an ever-increasing role in improving agricultural productivity with less environmental impact. Large-scale data collection from monitoring of the environment, weather, soil, pests, etc. can now be combined with the application of bio-pheromones to advance sustainable agricultural practices.

Imagine systems of sensors or camera-equipped pheromone traps deployed across fields. Constantly detecting and reporting the presence of insect pests of interest, these monitoring systems allow for GPS-guided sprayers or drones with automatic sprayer systems to be dispatched to the sensor locations to deliver natural pheromone solutions to disrupt pests. All happening in real time, of course.

The future is promising as cost-effective bio-pheromone applications can now compete with broad-spectrum chemical PPPs in large-scale row crop applications. Bio-pheromones can match all existing applications of chemically synthesised pheromones, replace certain synthetic chemical pesticide applications as well as many applications currently being satisfied with synthetic chemical insecticides. Bio-pheromones will relegate synthetic chemical pesticides to restrictive use in curative breakout control situations. The systemic benefits to environmental and human health offered by sustainable insect control with bio-pheromones is nothing short of a revolution.

In this series of articles, we will explore in more detail the use of bio-pheromones. Specifically, we will discuss pheromone applications for mitigating resistance, their use in combination with other IPM methods and with precision Ag technologies. We will also explore how advances in formulation technology can be applied to bio-pheromones, how expanded vector control applications are now possible and, finally, how the broad application of bio-pheromones can contribute to an overall reduction in CO₂ footprint.



Bio-pheromones can now be applied using conventional sprayers in low-margin row crops

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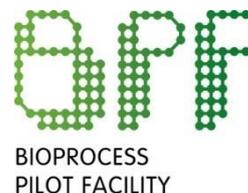
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