Could biopesticides be a green alternative?

- Increasing focus on biopesticides
- Next big thing in crop protection?
- Products already available

By Adrian Bell

If the hype is to be believed, biopesticides are the next "big thing" in crop protection and they are being put forward as a green alternative to pesticides, but what are they and are they really a green alternative?

Derived from a whole range of natural materials – animals, plants, insects, minerals and bacteria – their environmental risk is considered lower than "traditional" chemically derived pesticides, opening up new opportunities for crop protection companies and their customers – especially as some of them are approved for organic production too.

In fact, the combination of their eco-friendly public perception, the ever-increasing costs and regulatory demands of developing new conventionally based products and the attraction of a whole as-yet-unexplored market sector appears to have pushed the value of the biopesticide market from zero to hero almost overnight. Last year it grew by 10% and in 2013 growth is expected to hit 15%.

Despite such impressive growth figures, biopesticides' global share of the crop protection market is a paltry 3% – just $1.5bn (£0.96bn) out of a market worth $44bn (£28bn). Yet the realisation that this wasn't just a passing fad to counter the environmental lobby came in July last year, when Bayer CropScience paid $425m (£270m) to acquire AgraQuest, a US-based company widely regarded as one of the sector's pioneers.

ACQUISITION TRAIL

Bayer labelled the deal "of strategic importance". A slew of similar acquisitions followed, Syngenta bought Pasteuria and BASF picked up Becker Underwood. Monsanto had already taken Divergence and Beeologics under its corporate umbrella. Even though most deals were made in the USA – currently the sector leader – Europe isn't far behind, with the UK in particular a hotbed of activity.

One of the reasons for the sharp increase in interest in biocides is pressure from regulation. More than 70% of all available traditional crop protection products became illegal overnight when the EU implemented the 2011 Plant Protection Products Regulation.

The race was on to find alternatives – and it wasn't limited to Europe. The USA is now the leader in this field, owning 40% of global market share. Domestically, most US sales are going to mainstream, conventionally grown crops, suggesting this is not a market limited to niche organic growers.

PRODUCTS ON THE MARKET

What biopesticides, or products with a "natural" claim, are available?

NATURALIS-L (TRADE NAME): INSECTICIDE

Based on the fungus Beauveria bassiana, Naturalis is a fully fledged "bio-insecticide". The fungus grows naturally in soils throughout the world, where it is a parasite on various insects. First discovered in 1835, it was identified by an Italian scientist as the cause of a silkworm disease.

When the spores settle on an insect host, they germinate and penetrate its body, growing inside it and killing it within days. Depending on the strain of the fungus, it can either be considered a non-selective insecticide (and therefore, unsuitable for use on plants that rely on pollinating insects), or highly specific.

B bassiana is not without controversy. Earlier this year, a GM form of the fungus was found to have leaked from a containment area at Lincoln University in New Zealand.

REX

Spinosad is approved for use on veg crops such as broccoli and sprouts.

AQ10 (TRADE NAME): FUNGICIDE

AQ10 is based on a naturally occurring fungus, Ampelomyces quisqualis, which parasitises powdery mildew. Its properties were discovered in 1930, but it took until 1986 before a suitable strain was isolated. The first commercial products were made available in 1994 and it is now approved for use in nine EU countries, on crops such as tomato, courgette and cucumber.

Among its claimed advantages are an ability to reduce the risk of powdery mildew becoming resistant to chemical fungicides, as well as no harvest interval and an approval for use in some organic systems. Because the parasite also attacks powdery mildew spores, it can also help reduce the risk of the disease overwintering – a particular problem for many of the target crops, which are often grown under protected conditions.

And that is one of the product's main drawbacks – it can only be used effectively within a closed environment such as a glasshouse.

IRON PHOSPHATE (FERRIC PHOSPHATE): SLUG PELLETS

Ferric phosphate slug pellets have been marketed to the agricultural sector as a valuable alternative to methiocarb- or metaldehyde-based pellets. While not much is made of its "natural" origin in this market, home and garden customers are regularly reminded that iron phosphate is "natural".

But iron phosphate may not be all that green. Iron phosphate on its own is a safe compound that is not easily digested and is largely non-toxic. In fact, it won't generally kill slugs until it's combined with a synthetic chelating agent, usually EDTA or, in the UK, EDDS. The chelating agent makes the iron more soluble and allows the iron to be transported much more easily into the body cavity of slugs and snails, thus rendering it more toxic.

But EDTA is itself harmful to certain organisms – particularly to earthworms, which may concern farmers and growers looking to maintain field biodiversity. Additionally, while the effect of using a

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Indeed, biopesticides have not yet achieved widespread acceptance by the organic movement.

"We expect a lot of forward-thinking growers to start demanding these products in the near future, and we will take demand into account when evaluating their efficacy," says Ben Raskin, head of horticulture at the Soil Association. "When we receive a submission for a Soil Association licence, we look very carefully at the environmental effects on plants and mammals," he emphasises.

metal in solution is often a desired effect, there are also drawbacks and less beneficial side-effects; not all metals are desirable in solution, either to plants or the environment in general. Mobilisation of these heavy metals in the soil potentially affects their uptake by plants, or their movement into groundwater. A further concern is that substances such as EDTA – known as chelators – may alter ecosystems since they do not degrade quickly.

SPINOSAD: INSECTICIDE

Based on a compound found in a bacteria isolated from soil found inside an old sugar mill in the Virgin Islands, the insecticide was found to have a novel mode of action through both contact and ingestion. A further attraction has been an absence of any cross-resistance to any other known insecticide class.

First registered in 1997, spinosad – although largely now synthesised – is considered a natural product and is another organic-approved compound in many countries. Its LACK OF? toxicity to mammals has seen it approved for use not only in agriculture, where it is commonly employed as a grain insecticide, but also as a flea treatment for cats and dogs.

AND WHAT ABOUT BIOHERBICIDES?

Fungicides and insecticides seem to abound, but could the next big active be a bioherbicide?

While there are currently no bioherbicides approved in Europe, researchers in the USA and Canada are working on products that could help in the struggle against herbicide resistance.

Marrone BioInnovations, a pioneering US company, currently has three bioherbicides in development, with the first – Opportune – due for launch this year after receiving approval from the US Environmental Protection Agency. It is based on a compound isolated from the microbe Streptomyces sp and can be used as a post-emergence broad-leaved herbicide, or in any crop before planting. Maize, wheat and rye are non-susceptible, and it will control glyphosate-resistant weeds.

Manufacturers don't just see biopesticides as a "green" alternative, but rather as improved products. One route being investigated by several companies is a biochemical hybrid - nature's best coupled with the laboratory's top performers. Scientists think that with insects able to develop resistance to new insecticides within just a few generations, they may be able to extend the life of individual products by rotating them with the biopesticide.

Bayer has achieved something similar in the USA, with a product called Poncho/VOTiVO. Poncho (clothianidin) is already familiar to many UK growers, but this hybrid seed dressing product combines the systemic insecticide with a unique bacteria strain that lives and grows with young roots to offer protection against a range of nematodes that would otherwise cause root damage. According to the firm's figures, the higher yields delivered by the product were gaining farmers up to $61/ha extra for their maize crops.

Back in the EU, a number of biopesticides or biopesticide-like products are already in use on farm. Approval in the UK is granted through the Chemicals Regulation Directorate (CRD), which treats a biopesticide largely in the same way as a conventional pesticide.

"We classify biopesticides into four categories," says a CRD spokesman. "Products based on pheromones; those based on micro-organisms; those using plant extracts, and other novel alternative products.

The environmental risk from spraying biopesticides is considered lower than from "traditional" chemically derived alternatives.

"Before any pesticide can be used, sold, supplied, advertised or stored, it must be approved for use – that's what the regulations say and that's how we police it."

SHORT-TERM OBJECTIVES

But essentially it remains a scheme based on the chemical model and, according to researchers, that's stifling innovation in the sector. By emphasising the costs, rather than the benefits, critics say there's a danger that issues of sustainability will be overlooked in favour of short-term objectives.

There are concerns that the complex, highly regulated EU system, that relies on national authorisations, EU-wide arrangements and mutual recognition between states, won't work for biopesticides. Proponents are instead calling for a more tailored system,

But it is worth remembering that the "natural" origin of an active substance does not make it automatically "safer" – conventional pesticides have for years been very well-regulated, requiring a huge amount of data to secure approval. Should the requirement be any less onerous, simply because the product originated in nature rather than a lab?

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