

STILL VERY FEW SOLUTIONS but great hopes



Biocontrol is moving forward on a strong tide of dynamism and expectation, but it will need to make further progress before it can help to radically change arable crop protection.

Many businesses and research teams are involved in the biocontrol sector. However, the 30 or so approved substances for arable crops currently remain quite limited. Research organisations are working towards their integration into cropping techniques and the development of new ones.

Whether it is the official list produced by the Ministry of Agriculture or the ACTA index on biocontrol, current sources of information may give the impression that a large number of biocontrol solutions are available to protect crops. The official list as of 16th May 2018 contains no less than 81 substances or agents, to which micro-organisms should be added. The ACTA index comprises nearly 400 pages and 160 active substances and micro-organisms.

« In arable crops, the main solutions available are natural substances or micro-organisms. »

And yet, upon close analysis of approved substances for arable crops, we discover a somewhat narrower range, reduced to around 30 biocontrol substances or agents, i.e. only between 3 and 8 by type of crop, the majority of which are approved for organic farming. Far from covering the main targets in arable crops (weeds, pests and diseases), other major gaps are also found: there are no solutions for mildew in potatoes, beet cercosporiosis, or oilseed rape aphids or beetles, too few for wheat septoria and fusarium, and none for rusts. In addition, those solutions are not all effective enough or consistent enough, even when combined with other protection methods. Information from applied research and development organisations is more than ever needed to avoid disappointment.

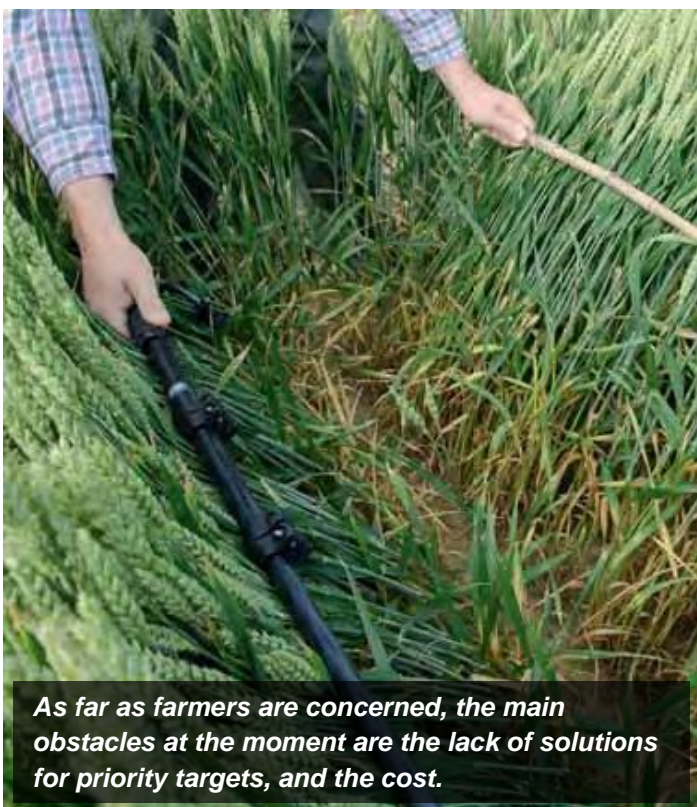
Innovations centred around micro-organisms and natural substances

In arable crops, the main solutions available are plant or mineral based natural substances or micro-organisms. Among the latter, some agents have already been approved for several decades, such as *Bacillus thuringiensis*. As they are live products, the packaging and formulation of some of those substances and agents are crucial in order to preserve their efficacy in storage, transport and during application, and farmers need to take new kinds of precautions.

Conversely, there are very few operational solutions involving macro-organisms. This technique involves using a biological control agent to control pests through parasitism, predation or interference with the reproduction cycle. Only one of those organisms is commonly used in arable crops: trichogram, a micro-hymenopterous parasite is used to control European corn borers in maize. This solution is often mentioned as an example of successful biological control, with more than 120,000 hectares of maize protected each year. This type of biological control by "inundation" remains rarely used in arable crops, and we have only identified two current research studies: Mediterranean corn borer control in maize by introducing another micro-hymenopterous parasite, and wireworm control with nematodes. In spite of major successes abroad (apple tree codling moth), the sterile male insect technique, involving a massive release of sterile male insects, that copulate, without any issue, to the detriment of fertile males, is not

the subject of any research work in France to control pests in arable crops.

The only approved chemical mediator in arable farming is for controlling rice stem borers in rice, but this product is no longer used in France. However, chemical ecology is a field offering a high development potential for biocontrol. The aim of this line of work is to improve knowledge on the relationship between plant and pest, and, among other things, on the volatile compounds with a very strong attractive effect emitted by plants. This research could lead to solutions involving food confusion or mass trapping, and breeding of trap-crops or less attractive varieties. INRA has just launched a project designed to model insect pests' olfactory receptors, in order to sort more effectively attractive and repulsive molecules (DEMETER project). Sexual confusion (pheromones) is also the subject of a few rare research projects for arable crops. Arvalis is working on this method for wireworms, and the Centre français du riz for rice stem borers.



As far as farmers are concerned, the main obstacles at the moment are the lack of solutions for priority targets, and the cost.

Necessary integration into protection programmes

In the future, biocontrol solutions may help to overcome an impasse regarding chemical plant protection products, and even replace them, but they will also be used to reinforce a conventional solution, or as part of actual protection programmes. Strategies must therefore be developed to adapt to the characteristics of the new solutions, like shifting the dates of traditional product applications, reducing the amounts of active substances from chemical sources, or increasing treatment efficacy. By combining prevention, diagnosis and control methods, integrated protection is asserting itself as THE crop protection model, with biocontrol as

Obstacles need to be removed

Speeding up the development of biocontrol solutions that are useful to farmers requires:

- a Europe-wide agreement on the definition of biocontrol, and the review of some criteria used by France, that are leading to inconsistent rejection of some products;
- funding for research and industrial innovation,
- adjustment: to the specific nature of biocontrol substances, and of assessment conditions, experimentation methods and performance diagnostic tools; going from lab to field conditions can lead to failures for reasons that are not

one of its linchpins, along with agronomy, genetics and physical or chemical control.

Undeniable progress has been made over the last few years, but it remains slow. There is a momentum, but also a long way to go before effective protection can be achieved against all the bioaggressors that have a detrimental impact on production both in terms of yield and quality, without impacting profitability. Research must be even more ambitious and in tune with needs, including for small markets (beetle pests, for example). Above all, it must be extremely innovative, emulating fairly fundamental research work on the microbiota of cultivated plants. Like humans, plants host very large numbers of micro-organisms that can have an impact on health and interact with micro-organisms present in the environment. Funded by the Consortium Biocontrôle, the "BCM microbiome" research project has been launched and aims to characterise antagonistic interactions between micro-organisms and crop bioaggressors (wheat septoria and vine mildew). This analytical work is designed to identify new biocontrol solutions by developing the plants' own defences. Beyond simple protection, this type of approach closely examines the notion of plant health.

The outcome being a rather long way away, work must carry on to find new ways of implementing existing solutions, which is what technical institutes are doing. This research work is helping to make progress in the short term, but it must be encouraged and supported to the same extent as research into finding new protection pathways.

Nathalie Verjux - n.verjux@arvalis.fr

Jean-Baptiste Thibord, Claude Maumené

ARVALIS - Institut du végétal

Franck Duroueix - f.duroueix@terresinovia.fr

Terres Inovia

Frédéric Boyer - f.boyer@itbfr.org

Cédric Royer - royer@itbfr.org

Institut Technique de la Betterave

September 2018

A dynamic market

According to figures supplied by IBMA France, the French association of biocontrol product businesses (37 members representing 90% of the biocontrol market), sales increased by 25% between 2015 and 2016 (ADQuation survey for IBMA in June 2017), to reach 5% of the plant protection product market (110 million euros). The association has stated that its target is to reach 15% by 2025. Arable crops should benefit from this dynamic environment, especially since public policies continue to show signs of encouraging innovation.

Research advocacy

In France, research has progressively been organised around a few initiatives, to speed up the development of new biocontrol solutions. Most of them are networks of actors wishing to set up research projects as part of a partnership. Noteworthy examples include a mixed technological network (RMT) specialising in plant defences simulation; the Elicitra RMT, which is a public-private consortium specialising in biocontrol; and a Carnot Institute, Plant2Pro, that has made this subject part of its priorities. You can find more information on all those organisations at www.elicitra.org - www.plant2pro.fr/fr.

Find out more

You can find the institutes' technical guides on biocontrol at:

www.editions-arvalis.fr ("Cereal protection" pamphlets),

www.arvalisinfos.fr ("Choice and Decision" documents, Download Arvalis's trial results and recommendations section),

www.terresinovia.fr (oilseed rape cropping guide), www.itbfr.org.