From Science to Field
Grapevine Case Study – Guide Number 4

The Use Of Microbial Biocontrol Agents

Bottlenecks and conditions for adoption in different European grapevine-growing regions

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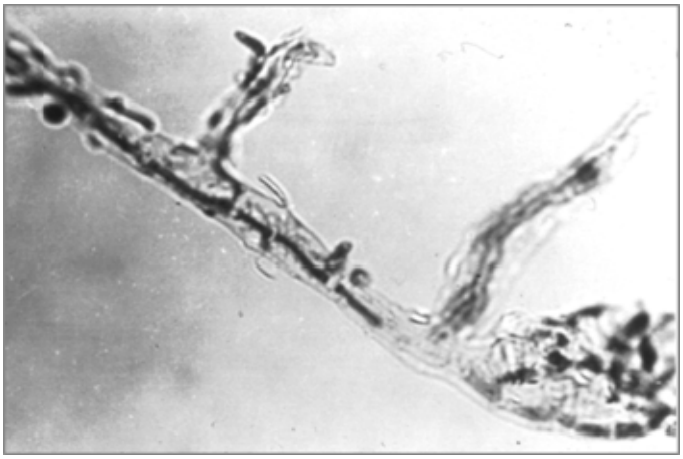

Clockwise from top left: *Ampelomyces quisqualis* colonizing a powdery mildew hypha; powdery mildew on berries; Shin-Etsu Isonet L dispenser; *Lobesia botrana* larva attacked by a chalcidoid ectoparasite. Photographs: ECOGEN, L. Mugnai, B. Bagnoli.

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The use of microbial biocontrol agents

What are microbial biocontrol agents and why use them?

Microbial biocontrol agents (MBCAs) encompass micro-organisms of different natures: according to the European Union 2009/1107/EC Regulation they can be viruses, bacteria and fungi. Their ability to act against a wide variety of pests, pathogens and weeds has led to their mass production and use in both covered and field crops as efficient tools to control various diseases, agents and crop pests. Their mode of action is extremely varied: they may directly start a lethal biological process or only suppress the bio-aggressor by competition. Sometimes they induce resistance factors in the plant.

Though MBCAs can be used in several covered crops and in some field crops, they are not extensively used on grapevine, despite their large potential as a replacement for chemical pesticides thanks to their low environmental impact, their safety for human health (no residues in grapes and wine) and, very relevant, the fact they do not induce pesticide resistance.

This is the case of two among the most successful MBCAs: *Bacillus thuringiensis (Bt)*, a bacterium acting as a microbial insecticide thanks to the toxin it produces, and *Ampelomyces quisqualis (Aq)*, a fungal antagonist of one of the most harmful group of pathogens, powdery mildew agents.

Prerequisites for the application of microbial biocontrol agents

For the application of MBCAs, some conditions need to be satisfied, and these usually go beyond those required for chemical pesticides.

> As for any active substance, registration is legally required for all MBCAs at both EU level for the active ingredient (inclusion in 'Annex 1'), and at each country level for the commercial product and for each crop. Therefore the availability of registered commercial formulations is an essential prerequisite. *Aq* is currently available in Italy and Switzerland, while *Bt* is also available in Chile, France, Germany and Hungary. Beside this, there are more conditions to be satisfied.

> Main point: farmers and advisers trained in the application of MBCAs
> Availability of economically competitive products
> Availability of efficient strains selected against the main grape pathogens and pests
> Suitable environmental conditions
> Suitable registration procedures and regulations.

Factors affecting the efficacy of the selected MBCAs

Product	*Bt*	*Aq*
Availability of locally adapted strains		x
Decision support tools	x	x
Time of application	x	x
Interaction with chemical products		x
Application technique		x
Cultivar/host characteristics		?
Environmental and climate extremes or conditions	x	x
Characteristic of the target organism	x	

Factors influencing the decision of growers to use selected MBCAs

Management criteria:

> Main point: Awareness about environmental and health issues
> Main point: Competitive market advantage (demand for grapes and wine with no residues)
> Relevance to the grower of being an innovator
> Adoption of organic viticulture management
> Adoption of Integrated Pest Management (IPM)

> Affordable costs (good cost/efficacy relationship)

Basic tool selection criteria:

> Main point: Occurrence of pesticide-resistant strains
> Main point: Reduced availability of pesticides on the market
> Availability of effective and reliable MBCAs (replicability of outcome)
> Easy application protocols in the vineyard.

Bottlenecks for use of selected MBCAs in different countries

Bottlenecks	Chile	Germany	France	Italy	Netherlands	Switzerland	Hungary
Regulation not adapted to MBCAs	xx	xx	xxx	xxx	xxx	xxx	xxx
Registration costs too high for target market	xxx	xxx	xx	xxx		xx	xx
R&D lacks open field programmes	xxx	x	x	x	xxx	xxx	xxx
Screening not adapted to commercial fitness	xx	x	xx	xxx	xxx	xx	xxx
Concept efficacy not always adapted to biologicals	xxx	x	x	xxx	x	xx	xx
Training and education	xxx	x	xx	xxx	xx	xx	xx
Lack of extension and promotion for MBCA use	xxx	x	xx	xx	xxx	xx	xx
Efficacy inconsistent (*Aq*)	xxx		xxx	xx		xxx	xxx
Effect overly influenced by environmental factors	xxx		xxx	xxx		xxx	xx

Many gaps prevent the wider promotion of MBCAs. They are for a large part related to the attributes and performances of the products themselves:

> MBCAs are considered as relatively complicated to use, require time and effort, and provide results not always confirmed in practice.
> They are often very sensitive to environmental conditions.

In conclusion, we can confirm that MBCAs are certainly effective and offer a very useful contribution to the preservation of plant health. However, they cannot be considered as unique replacement tools for pesticides. Similar to all IPM components, such as breeding or cultural prevention measures, although they may offer unique control solutions (for example, where there are bans or an absence of chemical pesticides), MBCAs must be considered as tools that are part of integrated methods which, used at the right time and according to good conditions, provide a satisfactory result.

Furthermore the regulations, mostly an extension of rules developed for chemical pesticides, are not adapted to MBCAs. Finally, substantial efforts need to be undertaken in R&D and for the promotion of these biologicals.

Specific bottlenecks for *Bt*:

> Poor knockdown effect
> Susceptibility to excess of light and temperature.

Specific bottlenecks for *Aq*:

> Tolerance to chemicals applied
> Establishment of the microorganism in the environment towards autoctonous species occupying the same ecological niche
> Compared to chemicals, effect is not immediate and efficacy is often lower if not applied with the appropriate timing
> Need to be favoured with suitable cultural and crop protection practices
> Evaluation of the need to select local biotypes which are better adapted to local conditions.

The use of microbial biocontrol agents

How to promote the dissemination of MBCAs in Europe

The gaps mentioned in this leaflet indicate clearly the actions to be undertaken in order to promote the selected MBCAs *Bacillus thuringiensis* and *Ampelomyces quisqualis*, and all MBCAs in general.
These actions can be summarised within an action plan:

> Policy for supporting and stimulating the adoption of environmentally safe, sustainable agriculture

> To undertake R&D studies aiming at solving the gaps and weaknesses of the products required for the targeted problems

> To adapt the regulation process (i.e. registration criteria and requirement, registration process) for biologicals

> To develop voluntary education programmes for advisers, trainers and farmers

> To develop proper communications to consumers and growers

> Improve communication on application protocols and on efficacy to advisers and growers, also by demonstrative field trials

> To provide incentives (reduced taxes) and acknowledgment (labelling and certification) to growers who use MBCAs.

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About ENDURE

ENDURE is the European Network for the Durable Exploitation of Crop Protection Strategies. ENDURE is a Network of Excellence (NoE) with two key objectives: restructuring European research and development on the use of plant protection products, and establishing ENDURE as a world leader in the development and implementation of sustainable pest control strategies through:

> Building a lasting crop protection research community

> Providing end-users with a broader range of short-term solutions

> Developing a holistic approach to sustainable pest management

> Taking stock of and informing plant protection policy changes.

Eighteen organisations in 10 European countries are committed to ENDURE for four years (2007-2010), with financial support from the European Commission's Sixth Framework Programme, priority 5: Food Quality and Security.

Website and ENDURE Information Centre:

www.endure-network.eu

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