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1. http://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides_en

2. UN (2017) *Report of the special rapporteur on the right to food.* Thirty-fourth session of the Human Rights Council Feb – March 2017. Report UN A/HRC/38, 24pp.

3. Calvo, F.J., *et al*. (2012). Biological control-based IPM in sweet pepper greenhouses using *Amblyseius swirskii* (Acari: Phytoseiidae). *Biocontrol Sci Technol,* 22: 1398–1416.

European Commission

Science for Environment Policy

Natural enemies of crop pests will feature in the future of environmentally friendly farming

Biological control agents are an environmentally-friendly way of controlling pests and diseases on crops and are advocated in the EU's Sustainable Use of Pesticides Directive[1]. The authors of a new review of the current state of biological control refer to a recent UN report[2] which states that it is possible to produce enough food to feed a world population of nine billion with substantially less chemical pesticides — and even without these pesticides if sufficient effort is made to develop biocontrol-based Integrated Pest Management (IPM) methods. The study suggests that policy measures can speed up the development and use of environmentally-friendly crop protection.

Augmentative biological control (ABC) involves the mass production of natural enemies of pests and diseases in the form of predators, parasites or micro-organisms, which are then released to control crop pests (including diseases and weeds). These living pesticides are collectively called 'biological control agents'. As it offers an environmentally and economically sound alternative to chemical control, ABC is not just of interest to commercial growers, but to retailers, consumers and policymakers.

In this new overview, the researchers describe the important role currently played by biological control and list the many hundreds of agents in use. They argue that ABC is an important part of sustainable agriculture and that new policy measures can promote its use.

Modern ABC began in the 1880s, when the pathogen *Metarhizium anisopliae*, a fungus, was used to control wheat grain beetles (*Anisoplia austriaca*) in Russia. Today, it is applied in many areas of agriculture, including fruit and vegetable crops, cereals and sugar cane, often forming part of integrated pest management (IPM), as required by the Sustainable Use of Pesticides Directive. The researchers estimate it is used on 30 million ha worldwide. A particular recent success story is found in Almeria, Spain, where chemical pesticides used on greenhouse-grown sweet peppers were completely replaced by the predatory mite (*Amblyseius swirskii*) and a parasitoid wasp (*Eretmocerus mundus*), over the course of two years[3].

The market for biological control agents has been growing by 15% a year since 2005 and some insects are produced in huge quantities to meet demand. For example, more than a billion of predatory Swirski mites (*Amblyseius swirskii)* are sold every week in Europe to control thrips and whiteflies in greenhouse vegetables and nursery crops. The banning of a number of pesticides in the EU may be one reason for the increasing use of ABC. However, the researchers estimate that the global market for ABC was USD 1.7 billion (€1.45 billion) in 2015, representing only 2% of the value of the conventional pesticide market.

Europe is the largest commercial market for invertebrate control agents, partly due to political support, but also because of consumer demand, according to the researchers. About 350 species are in use worldwide, with 170 of these available in Europe, for instance the parasitic wasp, *Encarsia formosa*, which attacks whiteflies. With several large commercial European producers, there are also many small enterprises, while some countries (e.g. China and India) have government-owned production units.

As well as pest-consuming insects, microbial agents can be used to combat diseases and insects. For example, the bacterium *Ampelomyces quisqualis* works against powdery mildew on grapes. At least 209 microbial agents are commercially available worldwide, according to the study, also mostly produced by small- to medium-sized companies. However, multinational agro-chemical companies and several new start-up companies are beginning to enter the market for so-called biopesticides.

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Natural enemies of crop pests will feature in the future of environmentally friendly farming *(continued)*

According to the study, the advantages of ABC in contrast to synthetic chemical pesticides are:

- it reduces risks to the health of farm workers;
- no break before harvesting is required (with many chemical pesticides, a 'pre-harvest interval' is legally required between spraying and harvesting during which time levels of pesticide residue decline);
- no re-entry interval (with many chemical pesticides, a 're-entry interval' is legally required between spraying and re-entering the crop to perform crop maintenance work in order to avoid exposure of crop workers to pesticides);
- it is the more sustainable method, as there is no development of resistance in pests;
- the method is non-toxic to plants and, therefore, produces better yields;
- it has potentially lower greenhouse gas emissions.

A major advantage is that they leave reduced residues. In Europe the Maximum Residue Level[4] sets limits on the amount of chemical residue that can be left on produce for sale. Member States are required to monitor foods in accordance. Retailers may favour producers whose food has low residue levels, say the researchers, making it advantageous to use ABC. In addition, consumers are increasingly interested in food safety and environmental impact, therefore retailers can promote the advantages of ABC-protected foods in marketing.

According to the researchers, the uptake of ABC could be further boosted by measures in the EU, including:

- fast-track and priority registration of low-risk pest-control agents, in line with the substitution principle, whereby environmentally safer methods can substitute a synthetic pesticide;
- permanent and EU-wide registration under a specific protocol for ABCs;
- directly or indirectly subsidising the cost of ABC for growers (already used in Denmark, Spain, France and The Netherlands);
- application of pesticide levies (used in Denmark).

Removal of pesticides from the market due to observed detrimental environmental effects and evolving resistance in pests has also boosted the development of ABC. The EU project BIOCOMES is working to find and commercialise new and improved biological control agents, with some success; but the present study notes that the Nagoya Protocol of the Convention on Biodiversity (CBD) poses a problem in future development, where invasive pests have been exported outside their native range. The CBD gives countries sovereign rights over their genetic resources, therefore access to these resources, including biological control agents, requires agreement between parties. Gaining permission to collect samples of potential biological control agents, in countries where the invasive pests also originate, turns out to be difficult, according to the researchers.

Finally, the researchers argue that ABC would appear even more attractive, compared to chemical pesticides, if the external costs of the latter — e.g. disruption to ecosystems and their services, damage to human health through chronic exposure — were made explicit and levied accordingly and therefore reflect the true cost of production[5].

In conclusion, the researchers propose that using biological control as a first resort, as opposed to chemical control of pests, could form part of the transition to a 'conscious agriculture'. They use this term to refer to a type of agriculture which lies somewhere between organic and conventional, which respects the environment and maintains resources for future generations, as opposed to a method that concentrates on profit and externalising the cost of harmful effects on health and the environment.

4. EC Regulation 396/2005.

5. See: Food and Agriculture Organization (2014). *Food wastage footprint: full cost accounting*; Food and Agriculture Organization (2015). *Natural Capital Impacts in Agriculture*