European Commission

Science for Environment Policy

Reducing synthetic pesticide use on grapevines — a review of methods

Disease-fighting microbes, insect-eating predators and mating-disrupting pheromones are among the tools listed in a new review of methods that can be used to reduce synthetic pesticide use on grapevines in Europe. Using these alternative methods can reduce the environmental and health risks associated with chemical pesticides, but further development is required to make them attractive to growers.

07 March 2018
Issue 504
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Source: Pertot, I., Caffi, T., Rossi, V., Mugnai, L., Hoffmann, C., Grando, M. S., Gary, C., Lafond, D., Duso, C., Thiery, D. & Mazzoni, V. (2017). A critical review of plant protection tools for reducing pesticide use on grapevine and new perspectives for the implementation of IPM in viticulture. *Crop Protection*, 97, 70-84.

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Grapes (*Vitis* spp.) are one of the world's most important crops. However, to meet quality standards, they often require intensive application of pesticides — especially fungicides to fight diseases such as mildews (caused by *Plasmopara viticola* and *Erysiphe necator*) and grey mould (*Botrytis cinerea*). Insecticides are used less often, though up to 10 applications per year may be required on fruit grown for the table.

Environmental and health risks associated with chemical pesticides, plus the risk of growing resistance to currently used products, have stimulated research into alternative methods of pest management. In order to reduce reliance on synthetic pesticides, grape growers need to use a combination of tools, say the researchers, in addition to practices designed to reduce incidence of disease (e.g. maximising air flow around vines, good hygiene and removing diseased material). In this review, they outline promising methods for application in Europe, taking into consideration the dominant market for wines typical of certain regions, produced from traditional varieties. For example, barrier methods such as insect-proof nets or plastic covers are not well accepted in Europe, partly because of their negative visual impact, but also because they do not suit the cultivation of the traditional varieties grown. The research, part of Project Pure, was supported by the EC's Seventh Framework Programme[1].

Growing grape **varieties resistant to mildews** is one solution for reducing reliance on fungicides, though it is not sufficient by itself. These have mostly been bred by hybridising European and American species of *Vitis*. In the past, such hybrids gave wine an unpleasant flavour, but advanced breeding efforts and identification of the genes responsible for these flavours is now overcoming this problem, note the researchers. Genetic modification may also allow resistance to be transferred from wild relatives. A list of disease-resistant varieties was published in a European catalogue in 2011[2], but uptake among growers and winemakers has not been strong — indeed, these varieties may not be permitted in some areas with protective laws related to viticulture. Resistance levels in these varieties will also need to be monitored, the researchers say, as they may drop as mildews evolve.

Biopesticides, including **biofungicides**, based on botanical ingredients or microorganisms, are another intervention that may be used (although the EU does not distinguish between the synthetic or natural origin of active ingredients in legislation (Regulation (EC) 1107/2009)). A large number of biopesticides have been tested on grapevines, but few have been developed commercially, and nothing satisfactory has been found to work against downy mildew (*Plasmopara viticola*). Potassium bicarbonate, seaweed extracts and chitosan (made by treating the chitin shells of shrimp and other crustaceans with an alkaline substance) may be used on powdery mildew (*Erysiphe necator*) as alternatives to sulfur and chemical fungicides. Biopesticides are sensitive to extremes of temperature and, therefore, should be applied in mild conditions and degrade quickly, meaning they need frequent re-application. Their adoption has been limited, partly due to their cost, short shelf-life and lower effectiveness compared to conventional chemicals — indicating that ways to promote their use may need to be found.

Continued on next page.

1. The research was supported by the Seventh Framework Programme (FP7), which was the European Union's Research and Innovation funding programme for 2007–2013.

2. Lacombe, T. *et al*. (2011). Grapevine European catalogue: towards a comprehensive list. *Vitis*, 50 (2011): 65–68

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The use of pest- and disease-fighting microbes, meanwhile, is a promising avenue. The fungus *Trichoderma* has been shown to be effective against trunk diseases (e.g. canker), for example, and the bacterium *Bacillus thuringiensis* can be used against grape berry moths (*Lobesia botrana*), with success rates similar to that of synthetic pesticides, but its use in viticulture is currently limited, as its efficacy depends on applying it before eggs hatch. Research has shown that azadirachtin, extracted from the neem tree (*Azadirachta indica*) and kaolin may also selectively work on berry moths.

Research on **biological control** against pests, using predators or parasitoids, is limited in relation to viticulture, the researchers note. Vegetation between rows of vines, especially flowering plants, can enhance numbers of natural predators of pests, e.g. lacewings (Chrysopidae) and earwigs (Dermaptera), while parasitoids such as *Campoplex capitator*, *Phytomyptera nigrina*, *Dibrachys cavus* and *D. afinis* have been found to be effective against berry moths. There have been attempts to combat berry moths by releasing tiny parasitoid wasps, *Trichogramma*, but these may be less effective in hot, dry climates. The minute pirate bug (*Orius*), which predates eggs and young berry moths, could be considered for large-scale control programmes, say the researchers.

Semiochemical-based pest control methods, involving the release of pheromones, have also been investigated. These can prevent mating by disrupting communication between insects, but the method does not work well on dense populations. Affordable and effective pheromone dispensers are being developed, say the researchers, while application over large areas and several years is most effective. The reduced need for insecticides can, however, lead to an increase in other insect pests, which should, therefore, be dealt with simultaneously.

Mating can also be disrupted by non-chemical means, research has shown. In field tests, vibrations sent through grapevines prevented mating of 90% of the American grapevine leafhopper (*Scaphoideus titanus*)[3], which is a significant pest, as it spreads the bacterial disease flavescence dorée (*Candidatus Phytoplasma vitis*).

Herbicides are widely used to control unwanted plants aiming at reducing their competition, especially where water availability is the limiting factor. Cover cropping and tillage are alternatives to herbicides that were traditionally used before the invention of herbicides and are still used to reduce or avoid the use of herbicides. Various alternative techniques are used, also in combination with herbicides. For example inter-rows can be planted with various plant species or tilled, and in the rows, the soil surface is usually kept bare using mechanical weed control.

Finally, the researchers note that decision-support tools which collect and analyse information on crops can help growers to take the most appropriate actions with regards to pesticides. For example, vite.net® helps growers to calculate optimal doses and timing, depending on conditions, reducing fungicide applications by up to 44% in tests[4]. Combining such decision-support systems with other tools mentioned here could greatly reduce reliance on synthetic pesticides in viticulture, say the researchers. However, they note that solutions are still needed for nematodes, bacterial, phytoplasma and viral diseases, and potentially invasive alien species may also require attention.

3. Eriksson, A., Anfora, G., Lucchi, A., Lanzo, F., Virant-Doberlet, M., & Mazzoni, V. (2012). Exploitation of insect vibrational signals reveals a new method of pest management. *PLoS One*, 7(3), e32954.

4. Rossi, V. *et al*. (2014). Addressing the implementation problem in agricultural decision support systems: the example of vite.net®. *Computers and electronics in agriculture*. 100: 88–99.