ENDURE

European Network for Durable Exploitation of crop protection strategies

Project number: 031499

Network of Excellence
Sixth Framework Programme

Thematic Priority 5
FOOD and Quality and Safety

Deliverable DR1.23

Pesticide use in viticulture, available data on current practices and innovations, bottlenecks and need for research in this field and specific leaflets analysing the conditions of adoption of some innovations

Due date of deliverable: M42

Actual submission date: M42

Start date of the project: January 1st, 2007 **Duration**: 48 months

Organisation name of lead contractor: INRA

Revision: V1

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)	
Dissemination Level	
PU Public	X
PP Restricted to other programme participants (including the Commission Services)	
RE Restricted to a group specified by the consortium (including the Commission Services)	
CO Confidential, only for members of the consortium (including the Commission Services)	

Table of contents

Table of contents 2

1. Inventory of data available on prevailing strategies of crop protection and pesticide use in viticulture 3

1.1. Overview of the pesticide use in viticulture in the participating countries 3

1.2. Review of available data and possible data gaps in the countries participating to the Endure Grapevine case study 4

1.2.1. Sources of information 4

1.2.2. Observatories of pesticide use: the examples of Germany and France .. 8

2. Analysis of the bottlenecks and conditions for the reduction of pesticide use in viticulture 9

2.1. Major bottlenecks for the adoption of alternatives to pesticides 9

2.2. How to promote alternatives to pesticide use in viticulture 10

3. Gaps of information and research to promote 11

References 13

Summary 14

4. Annexes: Leaflets analyzing the conditions of adoption of some innovations 15

4.1. Reducing Herbicide Use With Cover Cropping And Tillage 15

4.2. Decision Support Systems 15

4.3. Mating Disruption For The Control Of Grape Berry Moths 15

4.4. The Use Of Microbial Biocontrol Agents 15

4.5. New Resistant Grape Varieties 15

1. Inventory of data available on prevailing strategies of crop protection and pesticide use in viticulture

1.1. Overview of the pesticide use in viticulture in the participating countries

Within the European Union, general information about pesticide use is available in the data bases of the Eurostat statistical services (http://epp.eurostat.ec.europa.eu/). Data are provided to Eurostat by the European Crop Protection Association (ECPA) that represents the crop protection industry. It gathers information from farmer panels, and sales and trade data. The last Eurostat report on pesticide use in Europe (Eurostat, 2007) analyses the 1992-2003 period.

On average, viticulture is the agricultural activity with the most intensive use of pesticides in mass of active substances per unit area (Table 1). In 2003 (and in the 25 member countries at that time), it used more herbicides than fruit production and arable crops, but less insecticides than fruit production. Fungicides represented more than 90% of the total mass of pesticides, due to an intensive use of inorganic sulphur (76% of fungicides). Yet viticulture used 80% more synthetic fungicides than fruit production, and 13 times more than arable crops.

Table 1. Dosage of plant protection products applied in 2003 on grapevines, fruit trees and arable crops in the 25 countries of the European Union (in kg active substance / ha).

	fungicides			herbicides	insecticides
	synthetic	inorganic S	Cu compounds		
viticulture	4.10	14.85	0.56	1.28	0.30
fruit trees	2.26	1.44	0.35	0.74	0.78
arable crops*	0.31	0.03	0.00	1.01	0.04

* cereals, maize, oilseed, potato, sugar beet
Source: Eurostat, 2007

Table 2. Dosage of plant protection products applied in viticulture in 2003 in the European countries with major wine production (in kg active substance / ha)

	total PPP[1] viticulture	*% inorganic sulphur*	total PPP[1] fruit trees	*% inorganic sulphur*	total PPP[1] arable crops[2]
Austria	12.2	*66*	12.9	*18*	0.6
France	32.6	*61*	16.5	*38*	1.5
Germany	31.1	*61*	20.5	*46*	1.6
Greece	20.3	*84*	9.3	*45*	0.5
Hungary	9.2	*54*	4.8	*35*	0.8
Italy	17.8	*56*	13.0	*10*	0.5
Portugal	49.6	*85*	4.1	*n.a.*	0.7
Spain	11.7	*82*	2.6	*15*	0.5
EU - 25	21.4	*69*	6.9	*21*	1.1

[1] including molluscicides and plant growth regulators
[2] including cereals, maize, oilseed, potato, sugar beet and other arable crops
Source: Eurostat, 2007

There are strong discrepancies among European countries in the average use of pesticides. In viticulture, it ranged in 2003 from 9.2 kg/ha (54% inorganic sulphur) in Hungary to 49.6 kg/ha (85% inorganic sulphur) in Portugal (Table 2). The ranking among countries was different for fruit trees and for arable crops.

Such global figures, at country or continental scale, with all types of production systems mixed, do not enable (1) to analyse the determinants of pesticide use, which can relate to the environmental, economic and social context of viticulture, and (2) to identify the possible leeway for changing practices of crop protection. To this end, data at farm scale should be gathered, together with the regional context of soils, climate, and organisation of the wine industry.

1.2. Review of available data and possible data gaps in the countries participating to the Endure Grapevine case study

1.2.1. Sources of information

Viticulture is very diverse among the countries represented in the Endure Grapevine case study (Table 3). It varies in terms of vineyard area, of orientation (the relative importance of organic viticulture varies among coutries from 1 to 6), and of grapevine varieties. It also varies, including within each country, in terms of climates, of soils, and of pests and diseases pressure.

Yet, it is noteworthy that the major pests (grape bud moth and vine moth) and diseases (powdery mildew, downy mildew, botrytis and wood diseases) are shared by most vineyards, with regional variations in intensity (e.g. downy mildew dominates in the north of Italy whereas powdery mildew dominates in the south). Then, despite the high diversity of viticulture, alternatives to the use of pesticides for grapevine protection can be shared.

There is no centralised information about the collection of data on pesticide usage. In a survey carried out in 2008 by the OECD (OECD, 2009), it appeared that in the all 20 countries that responded sales data were collected through the pesticide industry. In only 13 countries, pesticide usage data were collected by agricultural or statistics or public health or environmental authorities, or by farmers' organisations; information could be collected through surveys with farmers, retailers or experts. The type and precision of data varied a lot. Among the countries represented in the Endure Grapevine study, only Germany and Switzerland responded to the OECD survey.

In all participating countries, a national service of statistics provides agricultural statistics, and the ministry of agriculture or the industry makes available a database of plant protection products (Table 4).

Data on the usage of pesticides in agriculture, and viticulture, are often dispersed and not easily available. In Switzerland, they may be found at the national office of statistics (OFS), in extension organisations, winegrowers associations (Vitiswiss), environmental organisations or at the Swiss Chemical Industry Association. In Italy, surveys on the different crop protection strategies have been carried out by institutions like Ismea (Istituto di Servizi per il Mercato Agricolo Alimentare, www.ismea.it) or Arsia (www.arsia.toscana.it), or companies like Nomisma (www.nomisma.it). In Chile, data on pesticide use should be gathered from academic and private consultants, winegrowers organisations and chemical companies.

The experiences of the Neptun data base and of the reference farms network in Germany, and of the national survey on agricultural practices in France offer new perspectives for the

analysis of the present state and of the dynamics of the farmers’ strategies of crop protection.

Table 3. Major characteristics of viticulture in the countries participating to the Endure Grapevine case study, in relation with crop protection.

	vineyard area[1]	types of viticulture[2]	major varieties	key pests	key diseases
Chile	195500 ha	1.6% organic	sauvignon, chardonnay, cabernet-sauvignon, carmenere, merlot	nematodes, vine moth (*Lobesia botrana*), *Pseudococcus viburni*, *Brevipalpus chilensis*, *Naupactus xanthographus*, *Parthenocanium corni*, *Proeulia auraria*	botrytis, powdery mildew downy mildew (depending on el nino) wood diseases
France	887500 ha	3.2% organic, 7% IPM	merlot, ugni blanc, grenache, carignan, cabernet sauvignon, syrah, chardonnay	grape bud moth (*Eupoecilia ambiguella*) vine moth (*Lobesia botrana*)	downy mildew powdery mildew botrytis wood diseases (esca, eutypa, black dead arm) flavescence dorée phytoplasma
Germany	102000 ha	4.3% organic, 1.5-2% IPM	riesling, müller-thurgau, pinot noir	vine moth (*Lobesia botrana*), grape bud moth (*Eupoecilia ambiguella*)	downy mildew black rot powdery mildew botrytis red brenner
Hungary	78000 ha	0.8% organic	cabernet franc, cabernet sauvignon, riesling, chardonnay	eryophid mites, vine moth (*Lobesia botrana*)	downy mildew powdery mildew botrytis flavescence dorée phytoplasma
Italy	843400 ha	4.8% organic	nebbiolo, sangiovese, moscato, trebbiano	grape bud moth (*Eupoecilia ambiguella*) vine moth (*Lobesia botrana*)	downy mildew powdery mildew wood diseases (esca, eutypa) botrytis escoriose root rot
Netherland	200-400 ha	10%	johanniter, solaris, merzling, regent, rondo	n.a.	downy mildew botrytis
Switzerland	14900 ha	2.2% organic, 80% IPM	pinot noir, gamay, merlot, chasselas	vine moth (*Lobesia botrana*), grape bud moth (*Eupoecilia ambiguella*), *Scaphoideus titanus*	downy mildew powdery mildew botrytis esca/eutypiose flavescence dorée phytoplasma

[1] source: OIV, 2006

[2] source for organic production: Willer et al, 2010

Table 4. Sources of information about grapevine protection in the countries participating to the Endure Grapevine case study.

	sources of information	web site
Chile	A national office of agricultural statistics (INE)	http://www.ine.cl/
	A database of plant protection products	http://www.sag.cl/
France	A national office of agricultural statistics (SSP)	http://agreste.agriculture.gouv.fr/
	A database of plant protection products (e-phy)	http://e-phy.agriculture.gouv.fr/
	National survey on agricultural practices (including crop protection) in 2006 (5200 fields), next in 2011.	
	Reference farm network in construction (FERMEcophyto, 50 wine farms in 2010)	
Germany	A federal statistical office + 6 regional statistical offices	http://www.destatis.de/
	A database of plant protection products (BVL)	http://www.bvl.bund.de/
	Neptun data base: surveys on PPP use (application frequency, application index), data available for 2003 and 2006, 113 vineyards in 2006	
	Reference farms network: differences in PPP use among regions and years (regional application frequency and application index), data available from 2007, 23 farms in 2007	
Hungary	A national office of agricultural statistics (HCSO)	http://portal.ksh.hu/
Italy	A national office of agricultural statistics (ISTAT)	http://www.istat.it/agricoltura/
	Databases of plant protection products	http://www.fitogest.com/ http://www.cra-pav.it/fpdb/bancadatibiologica/iniziale.asp (organic products)
Netherland	A national office of agricultural statistics (CBS)	http://www.cbs.nl/
Switzerland	A national office of statistics (OFS/BFS)	http://www.bfs.admin.ch/
	A database of plant protection products (OFAG)	http://www.blw.admin.ch/

1.2.2. Observatories of pesticide use: the examples of Germany and France

The NEPTUN project (Network for the Evaluation of the Pesticide Use in different Natural Areas of Germany) was launched in Germany to describe the intensity of pesticide use in agriculture (Sattler et al., 2007). It is a randomised and regionally stratified survey based on voluntary co-operation with farmers. Several crops were surveyed: arable crops (1999/2000), hops (2001), orchards (2001 and 2004), and vineyards (2003, 2006).

Its aim is to calculate a normalised treatment frequency index of pesticide application i.e. the number of pesticides used in a crop normalised to the soil surface area actually treated and to the ratio between the used application dose and the registered application dose. These results feed an environmental risk indicator, the SYNOPS model (Gutsche and Rossberg, 1997) in order to analyse regional differences in potential risk associated to use of pesticides, and its spatial distribution.

The Reference Farms Network is part of the National Action Plan for Sustainable Use of Pesticides in Germany. It started in 2007, with 66 arable farms (including 550 fields), 22 field vegetable farms (including 57 fields), 15 apple farms (including 37 orchards), and 9 viticulture farms (including 32 vineyards). The regional distribution of reference farms was made according to the regions defined in the NEPTUN surveys.

Its aims are to carry out annual surveys of pesticide use on the major crops and to analyse the potential for reduction of pesticide use. Treatment frequency indices are calculated (cf. Table 5 for viticulture) and an assessment of the minimum need of pesticide treatment is carried out by experts from the plant protection services. The distance between the treatment number recommanded by experts and the actual treatment number realized by growers can be evaluated.

Table 5. Treatment frequency indices* in various German viticultural regions, calculated from data collected within the Reference Farms Network 2007.

Viticultural region	fungicides	insecticides	herbicides	total
Mosel	15.6	1	1.5	18
Rheingau	17.3	0	1.1	18.4
Nahe	14.2	1.9	0.7	16.8
Rheinhessen	12.7	0	0.3	13
Pfalz	10.1	0	0.9	11.1
Baden	9.7	0.6	0.1	10.6
Württemberg	10.4	0.4	0	10.8
Germany	12.6	0.6	0.6	13.8

* also called Standardised treatment index (STI) in Sattler et al. (2007), or Application index (cf. Endure deliverable DR3.3)

In France, the statistical service of the Ministry of Agriculture and Fisheries (MAP-SSP) has carried out several extensive randomised and regionally stratified surveys on agricultural practices for field crops (1981, 1986, 1994, 2001, 2006), and only one in viticulture (2006, the next being prepared for 2011). In 2006, the management programme of 5200 fields from 10 viticultural regions was fully described in the survey.

The 2006 national survey in viticulture enabled to calculate a range of indicators about the use of pesticides and fertilizers, about canopy and soil surface management, about yield and costs. Comparisons could be made among regions (Table 6), and a typology of strategies of

grapevine protection was built. In each regions, strategies based on permanent crop (over)protection, integrated protection, and organic protection could be identified (Meziere et al., 2009). At last, scenarios of changes in strategies of crop protection were studied to evaluate the potential reduction in pesticide use in viticulture.

Table 6. Treatment frequency indices in various French viticultural regions, calculated from data collected within the national survey on agricultural practices 2006.

Viticultural region	fungicides + insecticides	herbicides	total
Alsace	10.2	0.8	11.0
Bordeaux	14.1	1.2	15.3
Burgundy	15.6	1.0	16.6
Beaujolais	14.2	1.6	15.8
Centre	8.6	0.8	9.4
Champagne	20.5	1.5	22.0
Charentes	13.5	1.1	14.6
Languedoc-Roussillon	9.4	0.9	10.2
Loire valley	11.0	1.3	12.3
Provence	6.8	0.6	7.4
France	12.7	1.1	13.8

Source : Mezière et al., 2009

In the framework of a national action plan for the reduction of pesticide use in France (Ecophyto2018, Baschet and Pingault, 2009), a network of reference farms is in construction for arable crops and in viticulture, together with a network of experimental fields presently managed by different institutions (research, extension services, agricultural schools…). A data base will gather data to track the changes in agricultural practices and evaluate the progress through a set of agricultural, environmental and economic indicators.

2. Analysis of the bottlenecks and conditions for the reduction of pesticide use in viticulture

2.1. Major bottlenecks for the adoption of alternatives to pesticides

An analysis of the conditions and bottlenecks for the reduction of pesticide use was carried out for five technical innovations:

- cover cropping and tillage for reducing herbicide use,
- decision support systems,
- mating disruption,
- microbial biocontrol agents,
- resistant grape varieties.

An analysis of each innovation was suggested by two main authors and discussed within the Grapevine case study group, with representants of contrasted viticultural regions.

The analysis has been detailed in five leaflets (annexed). The major bottlenecks for the adoption of alternatives to pesticides are the following.

a- The innovation should be available to farmers. For example, pheromones for mating disruption are not registered in Chile, Hungary and the Netherlands. Biocontrol agents are not registered in all countries due the high cost of registration in relation to

the size of the target market. Resistant varieties are registered only in Germany, Hungary, Switzerland and the Netherlands.

b- The innovation should fit with the legal organisation of the wine market. When geographically protected systems such as AOCs in France or DOCs in Italy impose specific cultivars, the introduction of resistant ones is impossible.

c- The innovation should not hinder the farmer's production objectives and organisation. For example, cover crops compete for the soil resources with grapevine, particularly in shallow soils and dry climates, which may result in yield and quality losses. Tillage limits soil trafficability, which may hamper urgent technical operations such as crop protection treatments in humid conditions. The adoption of new resistant cultivars necessarily has consequences on wine making.

d- The innovation should be compatible with the constraints of the local landscape. For example, in steep slope vineyards, mechanisation rests on very specific equipments, and technical options for soil surface management and spraying are limited. The management of mating disruption should be carried out on continuous vineyards with a minimum size of 5 to 10 ha. It is possible only in large farms, or with a strong cooperation among neighbour winegrowers.

e- The innovation should not be too expensive or should benefit from public support. It could be expected that the consumer would pay for the adoption of environment friendly cropping systems; it is not the case yet as wine is usually not marketed on this basis (except organic wines). For example, mating disruption is expensive, the product price varies a lot among countries, and its adoption is higher in countries and regions (Germany, Switzerland, Italy) where it benefits from public support. To use decision support systems, a lot of information is needed about regional and local weather and epidemics; it can be provided, at least partly, by public systems of weather forecast and simulation of phenology and epidemics.

2.2. How to promote alternatives to pesticide use in viticulture

The analysis of bottlenecks leads to recommendations that can be general and local.

At the EU and national scales:

- regulations should facilitate the diffusion of techniques leading to a reduction in pesticide use (registration of new resistant cultivars, adapted registration process for alternative products such as pheromones for mating disruption and biocontrol agents);
- a significant effort in R&D is needed to diversity the offer in alternative methods (biocontrol agents, resistant varieties, non competitive cover crops..), and decision support systems for the design and management of cropping systems with low pesticide use;
- acknowledgement (labelling, certification) would facilitate the identification by consumers of wines produced environment friendly.

At the regional and local scales:

- the geographical identification and marketing of wines should integrate the impact on the environnement of the whole production process; in this respect, all alternatives to pesticide use, including new resistant cultivars, should be authorized;
- collaborative networks of growers should be promoted and communication tools set up to facilitate the exchange of experiences, of information (decision support systems) and the management of pests and diseases at the scale of landscapes;

- a range of training tools should be developed for extension services, advisers, retailers and farmers to experiment and adapt innovations to the local conditions.

3. Gaps of information and research to promote

In relation with its analysis of the present state of pesticide use in viticulture and of the conditions for its reduction, the Grapevine case study group has identified research to promote in several domains.

Social sciences

- analysis of farmers' strategies of crop protection: comparison among farming systems and among production regions, economic, organizational and technical leeway for reducing pesticide use
- analysis of risk: evaluation of the risk associated to the reduction of pesticide use (yield and quality losses, change in labour organization…), acceptability of risk by growers
- acceptability of new technologies (e.g. new varieties), behaviour of leader vs. conservative growers

Plant pathology

- Interactions between plants and products with partial efficacy, including organisms of biocontrol, possible complementarity of these products
- biology and epidemics of wood diseases, idenfication of protection methods
- conditions of emergence of new diseases (sour rot, Esca…), pest and disease invasions
- effect of climate change on pest and disease dynamics
- effect of landscape (topography, distribution of vegetation) on the efficacy of mating disruption (diffusion of pheromones), relation between the efficacy of mating disruption and population dynamics
- possible resistances or tolerances to biocontrol agents, dynamics and survival of these organisms once in the field

Technology and engineering

- develop decision support for the management of biocontrol agents
- DSS for optimizing soil surface management and combine grapevine production with soil protection
- integration of the management of several diseases and of several methods of control in DSS in a global farmer's strategy
- precise application of plant protection products
- methodologies of screening of new organisms of biocontrol

Environmental sciences

- evaluation with multiple criteria of environmental impacts linked to pesticide use, at local and catchment scales

Genetics

- evaluation and adaptation of new resistant varieties in various regions with different climates, soils, cropping systems and production objectives, design of networks of experimental vineyards
- behaviour of the pathogen population in contact with genes of resistance, combination of various genes of resistance
- interactions of the new varieties with other pathogens than the targets (problems of sustainability)
- selection of cover crop species with short cycle and low competition for soil resources

Agronomy

- behaviour of spontaneous vegetation in vineyards, dynamics of species and resulting functions (cycle length, root depth, sensitivity to water stress…)
- relationship between cover cropping and the dynamics of downy mildew and other diseases: direct effects on the epidemiology, indirect effet through the grapevine vegetative vigour
- impact of crop management (training, fertilization, green cover, stresses…) on wood diseases
- design of specific cropping systems and wine-making strategies for new varieties, in order to fulfill objectives of production, plant health and sustainability of resistances

References

Baschet JF. Pingault N. 2009. Reducing pesticides use: the Ecophyto 2018 plan. The role of usage indicators in evaluating the achievement of targets. *Prospective analysis and evaluation* n°4, 4 p. (http://agriculture.gouv.fr/sections/thematiques/prospective-evaluations/publications9108/repertoire-notes-d/downloadFile/FichierAttache_12_f0/Analyse_n4_Anglais.pdf)

Eurostat, 2007. The use of plant protection products in the European Union. Data 1992-2003. Eurostat statistical books, 215 p. (http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-76-06-669/EN/KS-76-06-669-EN.PDF)

Gutsche V., Rossberg D., 1997. SYNOPS 1.1: a model to assess and to compare the environmental risk potential of active ingredients in plant protection products. Agriculture, Ecosystems & Environment, 64, 181-188.

Mezière D., Gary C., Barbier J.M., Rio P., Bernos L., Clément C., Constant N., Delière L., Forget D., Grosman J., Molot B., Sauvage D., Sentenac G., 2009. *Ecophyto R&D, vers des systèmes de culture économes en produits phytosanitaires*. Tome III, analyse comparative de différents systèmes en viticulture, MEEDDAT-MAP-INRA, 57 p. + annexes + abstract in English (http://www.inra.fr/content/download/21914/306246/version/1/file/Ecophyto_RD_tome_III_Viticulture.pdf)

OECD, 2009. OECD survey on countries' approaches to the collection and use of agricultural pesticide sales and usage data: survey results. *Series on Pesticides* No. 47. 34 p. (http://www.oecd.org/dataoecd/21/5/44033366.pdf)

OIV, 2006. Situation and statistics of the world vitiviniculture sector, 69 p. (http://news.reseau-concept.net/images/oiv_uk/client/Commentaire_statistiques_annexes_2006_EN.pdf)

Sattler C., Kächele H., Verch G., 2007. Assessing the intensity of pesticide use in agriculture. Agriculture, Ecosystems and Environment 119, 299–304.

Willer, Helga and Kilcher, Lukas (Eds.), 2010. *The World of Organic Agriculture - Statistics and Emerging Trends 2010*. IFOAM, Bonn and FiBL, Frick.

Summary

Objectives

The objective of deliverable DR1.23 is threefold:

- make an inventory of available data and possible data gaps on prevailing strategies of crop protection and pesticide use in viticulture, in the different participating countries and in the southern hemisphere (Chile) where a quite different context prevails;
- analyse the pre-requisites for the reduction of pesticide use in viticulture in regions with contrasted environmental and economic contexts, i.e. the conditions of acceptance of some technical innovations that are validated in the research labs yet still poorly disseminated;
- list gaps of information and research to promote in relation to the reduction of pesticide use in viticulture, in the fields of biological, agronomical or social sciences.

Rationale:

The activities of the Endure Grapevine case study group have been organized with three meetings as milestones:

- After diffusion of a template early 2009, all participating teams presented an analysis of the information available in their country during the kick-off meeting held in Bordeaux in March 2009. This information was aggregated and supplemented during the next months.
- Task TRA1.2a could be finalised at the second meeting that was organised during the Endure annual meeting held in Wageningen in October 2009. The group also identified a set of five technical innovations for which the bottlenecks and conditions of development would be analysed (task TRA1.2b). Two participants from different countries wrote a draft of a four-page leaflet during the next months.
- At the final meeting held in Florence in April 2010, the leaflets were extensively discussed, and research to promote was identified (task TRA1.2c).

Teams involved:

ACTA-IFV (France)
Agroscope (Switzerland)
CNR (Italy)
IBMA (Switzerland)
Inra (France)
JKI (Germany)
SZIE (Hungary)
Utalca (Chile)
WUR/PPO (the Netherlands)

Geographical areas covered:

Chile
France

Germany
Hungary
Italy
the Netherlands
Switzerland

4. Annexes: Leaflets analyzing the conditions of adoption of some innovations

4.1. Reducing Herbicide Use With Cover Cropping And Tillage

4.2. Decision Support Systems

4.3. Mating Disruption For The Control Of Grape Berry Moths

4.4. The Use Of Microbial Biocontrol Agents

4.5. New Resistant Grape Varieties

Reducing Herbicide Use With Cover Cropping And Tillage

Dissemination and bottlenecks in different European grapevine-growing regions

Christian Gary and Marc Fermaud, INRA, France

© Yvan Bouisson, INRA, France

endure
diversifying crop protection

Food Quality and Safety
6TH FRAMEWORK
PROGRAMME

Reducing herbicide use with cover cropping and tillage

In viticulture, the alternatives to herbicide use are cover cropping and tillage. However, these techniques are very classical (they were the usual way of managing the soil surface before the invention of herbicides), and herbicides are still used in the majority of European vineyards on either part or the whole soil surface.

A large range of technical options is available. Inter-rows can be covered with either weeds or mono- or plurispecific stands of annual or perennial herbaceous species. They can be tilled with various types of equipment (such as a mulcher, para-plough, rotating harrow, depth loosener, or grubber etc). One can alternate cover cropped and tilled inter-rows. Under the rows, more specific equipment must be used to maintain the soil surface either bare or covered.

Benefits and disadvantages of cover cropping:

> Cover cropping limits runoff and the resulting soil erosion and transport of pollutants (pesticide spread and/or residues on the soil) in surface water.

> Cover cropping increases water infiltration. In winter, it can be used as a catch crop and legumes can be a source of nitrogen.

> Because this vegetation competes for soil resources (water, nutrients) with grapevines, particularly in dry regions and/or shallow soils, this may generate yield and/or quality losses.

> Cover cropping reduces the vegetative vigour of grapevine and its susceptibility to grey mould and downy mildew.

> Cover cropping contributes to a better soil structure, and to an increase in the content of organic matter and in soil biological activity.

> Cover cropping improves trafficability in wet conditions.

Benefits and disadvantages of tillage:

> Tillage improves soil aeration and water infiltration and eliminates weeds; consequently the availability of water and nitrogen is higher for the grapevine.

> Tillage incorporates organic matter in the soil, and stimulates its decomposition.

> Tillage favours soil erosion in rainy conditions and in steep-slope vineyards.

> Tillage reduces trafficability in wet conditions.

Prerequisites for reducing herbicide use

> Specific equipment is needed for sowing and maintaining cover crops and for tilling. Different equipment is needed for soil surface management in the inter-rows and under the grapevine rows.

> The topography of the vineyard should enable mechanisation; steep-slope viticulture presents specific difficulties.

Factors affecting the efficacy of cover cropping and tillage

> The relative soil surface allotted to cover cropping (for example, every inter-row, one inter-row out of two etc) and the type of flora (grass versus legumes, root depth, duration of vegetative cycle) affect the intensity and dynamics of the competition for soil resources with the grapevine.

> The management of cover cropping and/or tillage affects competition for soil resources, the soil protection and trafficability in wet conditions.

Factors influencing the decision of growers to adopt cover cropping or soil tillage

Agronomic factors:

> Cover cropping and tillage generally improve the soil's physical and biological properties.

> Finding a trade-off between the benefits and disadvantages of cover cropping is difficult in regions with severe summer drought, low availability of soil resources (shallow soils), and high inter-annual rain variability.

> Fermentation for making white and red wines does not share the same sensitivity to nitrogen deprivation.

> On steep slopes, mechanisation may be impossible.

> Under conditions of high grapevine vigour, cover cropping is an efficient means for growers to reduce yield, and optimise grape quality.

Economic factors:

> Maintaining a cover crop or tilling is more costly (specific equipment, more time and energy consumption) than applying herbicides, particularly under grapevine rows where special equipment is needed.

> Abandoning herbicides is a condition for moving to organic viticulture; more generally, the environmentally positive image of reducing herbicide use can be used for marketing purposes.

Bottlenecks for reducing herbicide use in different European regions

		Competition with cover crop for soil resources	**Limited mechanisation**	**Soil erosion after tilling**	**Limited trafficability after tilling**	**Increase in labour and energy expenses for tilling**
Central and Northern Europe	**Shallow soils**	+ +			+ + +	+ + +
	Steep slopes	+	+ + +	+ + +	-	-
	Other				+ + +	+ + +
Mediterranean regions	**Shallow soils**	+ + +		+	+ +	+ + +
	Steep slopes	+ +	+ + +	+ + +	-	-
	Other	+ +		+	+ +	+ + +

Reducing herbicide use with cover cropping and tillage

How to promote the reduction of herbicide use in Europe

> Better marketing on environmental practices, certification (at present, only certification for organic agriculture has an impact on consumers' preferences).

> Design and diffusion of decision support systems (DSS) to manage and optimise cover cropping.

> Improvement of specific equipment for tilling and/or maintaining cover crops in zero-herbicide strategies.

> Selection of original species for cover cropping, with low growth rate and low resource demand.

> Development of biological control of weeds.

> Payment of subsidies to farmers conditional on compliance with environmental targets (agri-environmental measures).

> Limitation of the number of available registered herbicides.

For further information please contact:

France: Christian Gary (gary@supagro.inra.fr)
Germany: Christoph Hoffmann (christoph.hoffmann@jki.bund.de)
Hungary: Viranyi Ferenc (Viranyi.Ferenc@mkk.szie.hu)
Italy: Laura Mugnai (laura.mugnai@unifi.it)
Switzerland: Pierre-Henry Dubuis (pierre-henri.dubuis@acw.admin.ch)

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

This publication was funded by EU grant (Project number: 031499), under the Sixth Framework Programme, and is catalogued as Grapevine Case Study – Guide Number 1, published in July, 2010.

From Science to Field
Grapevine Case Study – Guide Number 2

Decision Support Systems

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

Pierre-Henri Dubuis, Agroscope ACW, Switzerland and Ferenc Viranyi, SZIE, Hungary

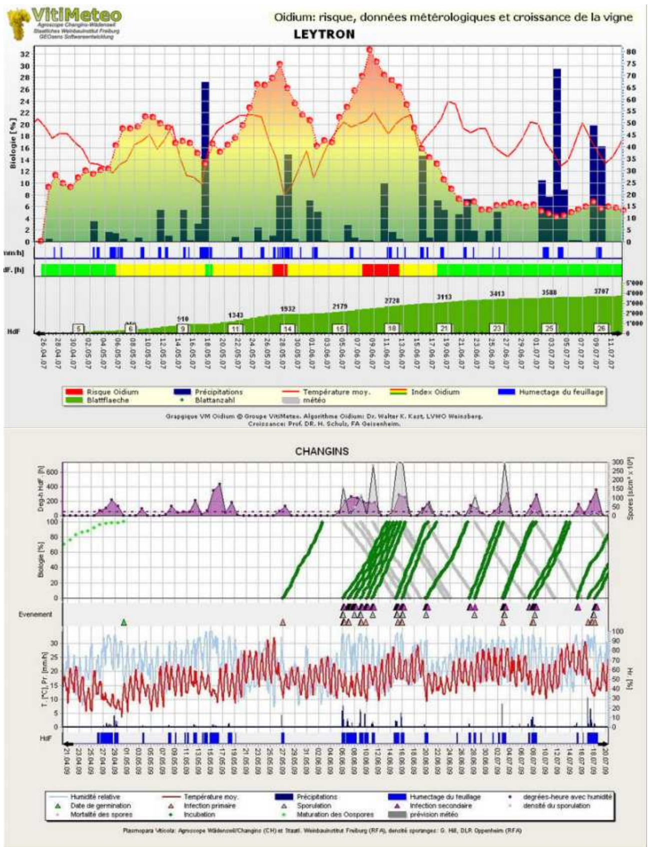


Photo left: Olivier Viret, Agroscope ACW, Switzerland. Images above: Agrometeo, Switzerland.

endure
diversifying crop protection

Food Quality and Safety
6TH FRAMEWORK
PROGRAMME

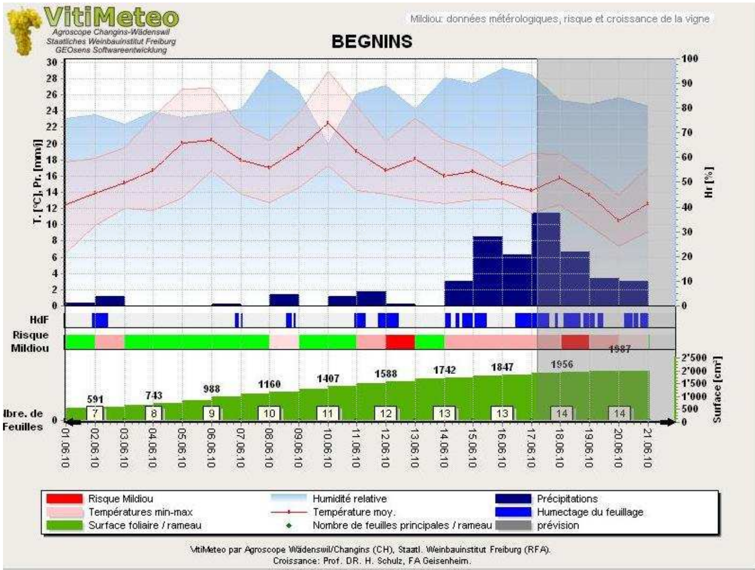
Decision Support Systems

The vast majority of vineyards worldwide are planted with *Vitis vinifera* cultivars, all of which are susceptible to the main fungal diseases affecting grapevine. Therefore, the use of fungicides is indispensable in order to produce high quality wines, even for organic viticulture. As public concern about use of pesticides and residues in wine is growing, Decision Support Systems (DSS) are a key element to help growers restrain pesticide applications to the minimum needed to ensure qualitative production.

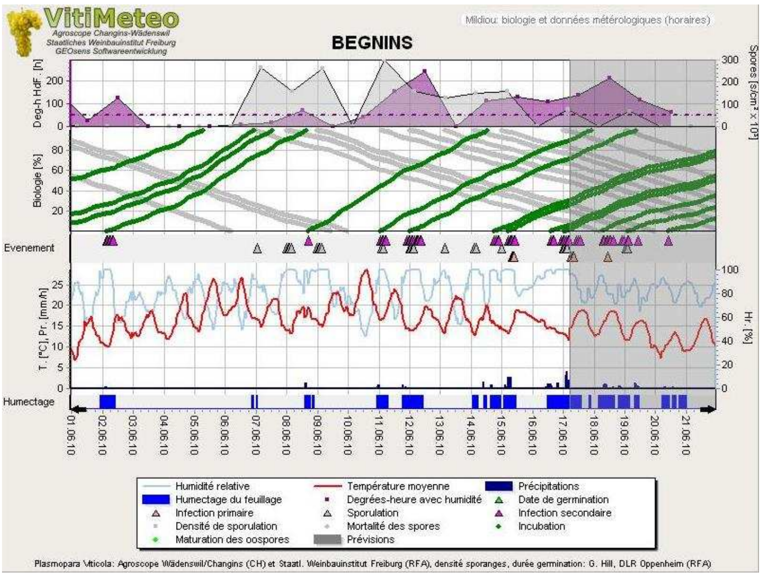
DSS offer much potential to reduce the pesticide input in integrated control strategies against the most important fungal diseases of grapevine. The principle of applying a pesticide only if needed is a basic element of Integrated Pest Management.

DSS use weather data in order to identify periods when the threat of infection is critical. Disease development models are now available for most of the main fungal pathogens of grapevine. However, there is intensive ongoing research to develop and validate disease forecasting which gives more accurate results and enables winegrowers to optimise their spray schedules.

Attempts to integrate both downy and powdery mildew are being conducted by researchers and, if successful, will provide excellent tools for growers to decide when to spray. In most Western European countries, extension organisations and private advisers already make wide use of DSS to write their spraying recommendations. However, practical and organisational limitations still often result in preventive spraying following a regular pre-defined schedule.



Online services such as www.agrometeo.ch seen here offer free information to growers. The VitiMeteo-Plasmopara model simulates the main development step of *Plasmopara viticola* using weather observations from across the country. Above you can see the results for the Begnins area, showing meteorological information, vine growth and downy mildew risk. Below it presents detailed information on downy mildew biology and meteorological statistics. © Agrometeo, Switzerland.



Summary of the major advantages in using DSS

The use of DSS is a central tool to improve the efficacy of plant protection by determining the right timing for fungicide sprays. It can also lead to a reduced number of sprays by avoiding unnecessary treatment with fungicides, particularly at the beginning of the season or during periods of low disease pressure.

On-site prerequisites for the application of DSS

> Qualitative weather data must be available at a local scale.

> Continuous validation by experts with field data (for example, symptoms, epidemiology and phenology).

> Skilled and trained growers and extension advisers (field observation, understanding of DSS outputs and implementation of adapted protection strategies).

> Precise dosage systems, such as those adapted to the leaf area to be sprayed.

> The quality of application is essential.

Local weather data is an essential prerequisite for DSS. © Olivier Viret, Agroscope ACW, Switzerland.

Biotic and abiotic factors affecting the efficacy of DSS

> Good quality spraying equipment is essential for precision viticulture.

> All organisational and structural factors which enable applications to be made on time and to react quickly to DSS recommendations (for example, availability of equipment and labour force, farm size, and cover cropping to increase trafficability).

> Extreme climatic conditions can lead to inaccurate modelling.

Factors influencing the decision of growers to use DSS

> Adjustment of forecasting parameters to regional conditions; local validation and adjustment of models and DSS by experts (to account for the effects of local microclimates, varieties).

> Economic information should be provided together with technical information (farmers want to know the possible benefits and potential losses).

> The training and technical level of the growers.

Bottlenecks for DSS use in different European countries

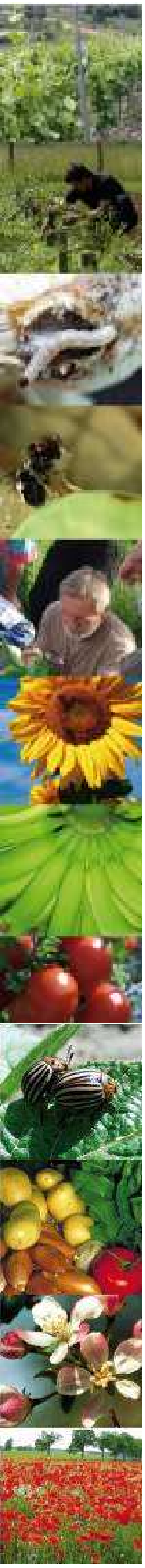
> Availability of precise epidemiological knowledge for some diseases or specific steps in the pathogen development cycle.

> Availability and cost of either weather data or a weather station network for a specific region.

> Continuous validation by experts and field observations are essential to support DSS use.

> Training and support must be available for the grower to understand and implement strategies linked to the DSS outputs.

> Availability of accurate models that integrate both downy and powdery mildew in order to help the grower in defining a global protection strategy.



Decision Support Systems

How to promote the dissemination of DSS in Europe

>Support the availability of weather data and develop weather station network(s) at local scales.

> Validation and follow up of the DSS.

> Support the development of new and 'user friendly' DSS, and the validation and comparison of existing DSS and models to increase the trust from farmers.

> Training of extension services, advisers and farmers about DSS use and strategies (for example, how to make decisions from information provided by models, how to integrate the information in the global farm management).

> Support the establishment of networks of farmers.

> Set up easy communication tools (new technologies) to deliver the DSS outputs extensively and free of charge for the growers.

For further information please contact:

Switzerland: www.agrometeo.ch (pierre-henri.dubuis@acw.admin.ch)
Germany: Christoph Hoffmann, JKI (christoph.hoffmann@jki.bund.de)
France: Marc Raynal, IFV (marc.raynal@vignevin.com)
Italy: Laura Mugnai, CNR-UNIFI (laura.mugnai@unifi.it)
Hungary: Viranyi Ferenc, SZIE (Viranyi.Ferenc@mkk.szie.hu)

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

This publication was funded by EU grant (Project number: 031499), under the Sixth Framework Programme, and is catalogued as Grapevine Case Study – Guide Number 2, published in July, 2010.

Mating Disruption For The Control Of Grape Berry Moths

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

Christoph Hoffmann, JKI, Germany; Denis Thiéry, INRA, France

Clockwise from top left: Female *Lobesia botrana* moth; Female *Eupoecilia ambiguella* moth; RAK dispenser; Isonet dispenser; Healthy grapes. © D. Thiéry and P. Goetgheluck, INRA, France and C. Hoffmann, JKI, Germany.

endure
diversifying crop protection

Food Quality and Safety
6TH FRAMEWORK
PROGRAMME

Mating disruption for the control of grape berry moths

About mating disruption

Mating disruption is an innovative and sustainable technique which makes it possible to reduce insecticide use in viticulture. Using this technique, air above and between the grapevines is saturated by female sexual attractants, naturally used by female moths to call males for mating.

So-called dispensers (see cover photographs) constantly emit the pheromone into the vineyard. The ubiquitous presence of pheromone leads to disorientation of the males and suppressed calling behaviour of the females, and possibly induces additional behaviours antagonistic with mating. The overall effect is to reduce the number of offspring produced by the pest and thus the damage.

In viticulture the technique is mainly used against two pests: the tortricid moth species *Lobesia botrana* and *Eupoecilia ambiguella* (Lepidoptera: Tortricidae). As an additional benefit, the technique could be developed rather rapidly against the leaf rolling *Sparganothis pilleriana*.

Why sustainable?

> Only affects the target pests (it is species specific).
> There are no negative documented effects on the environment, professional users or consumers.
> Easy to handle as it only needs to be applied once.
> No timing problems.
Despite these positive characteristics, mating disruption is not used on a large scale in Europe.

Prerequisites for the application of mating disruption

> Mating disruption is only effective in areas with a minimum size of around 5-10 hectares. In many parts of Europe it is unusual to find a single enterprise with such extensive vineyards. This means it is necessary for different winegrowers to cooperate.
> Low populations of the pest are required. This means that sometimes populations have to be reduced by insecticides at the beginning of the treatment.

Biotic and abiotic factors affecting the efficacy of mating disruption

> Too many additional landscape components between vineyards (such as hedges, woods, other cultures or fallows) may negatively influence the efficacy of mating disruption. These components should be treated with pheromones as well as the vineyards. This makes mating disruption more expensive in such richly structured areas.
> The deployment of the dispensers must be adapted to the topography.
> In areas with dispensers charged only with pheromone for two grape berry moth generations the efficacy will quite often be low in the case of a third generation. This might cause an increased population in the following year.
> In years with extreme temperatures there might be a premature cleanout of the dispensers.

Factors influencing the decision of growers to use mating disruption

> In areas where insecticide sprays are mandatory, for example against the leafhopper *Scaphoideus titanus*, using mating disruption is of no interest to growers.

> Compared to the spraying of insecticides, which can be impossible after heavy rain, the control of grape berry moths is less dependent on weather conditions during the vegetation period.
> Mating disruption is easier to manage than insecticide treatments because it does not require the monitoring of oviposition periods.
> The environmentally positive image of mating disruption can be used for marketing purposes.
> Mating disruption is currently more expensive than insecticide treatment.

Bottlenecks for mating disruption in different European countries

Table 1: Nature of limiting factors in different European countries (Y/N: in some regions yes and in others no)

	Registration RAK	Registration ISONET	Registration further products	State- aided	Suitable landscape agricultural structure	Too expensive	*Scaphoideus* control	% of vineyard area treated	Product price per ha (€)	Difficult to build up groups of cooperating growers
Chile	No	No	No	No	Y/N	Yes	No	0.0	N/A	Yes
France	Yes	No	No	No	Y/N	Yes	Y/N	2	200	Yes
Germany	Yes	No	No	Yes	Y/N	No	No	60	198	Y/N
Hungary	No	Yes	No	No	Y/N	No	No	0.1	120	Yes
Italy	Yes	Yes	No	Y/N	Y/N	Yes	Y/N	2	150	Yes
Netherlands	No	No	No	No	Y/N	No	No	2	200	Yes
Switzerland	Yes	Yes	Yes	Y/N	Y/N	No	Y/N	55	220	Yes

The absence of registered mating disruption products is a bottleneck in Chile and the Netherlands. Until now, only Switzerland and Italy has offered a choice between two different products. In general there is a lack of competition which makes the products expensive. Huge price differences are also observed between countries, for example France and Hungary. There are price differences between different dispenser types and also the products themselves can be charged with different amounts of active ingredient and different pheromone components. The dispensers can be charged only for one grape berry moth species or for both. But this can only partly reflect the different prices in Europe.

For all countries only parts of the area under viticulture are suitable for pheromone application because of the agricultural structure. In Germany and Switzerland, financial support is provided by regional governments, which promotes the high proportion of vineyards treated with this technique. In Italy, the application is only common in some regions where this support exists. The extension of Flavescence dorée and its vector, which is controlled by insecticides, can be a limiting factor to this technique. As the products require a certain area (at least 5ha) to be effective it is often a problem to gather together all the winegrowers in an area to apply the technique collectively.

Bottlenecks for mating disruption in different European countries

How to promote mating disruption in Europe

> Different European countries or regions provide government aid for the application of mating disruption. As a consequence, in Germany around 60% of the vineyard area is under mating disruption. One main reason for this is the financial state aid for the growers.

> Vine growers have to organise themselves into collaborative networks. Here private or official consultants can play a crucial role as moderators who can bring together vine growers in the same area.

> Pheromone application may be used as a marketing instrument for vine growers.

For further information please contact:

Switzerland: www.agrometeo.ch (pierre-henri.dubuis@acw.admin.ch)
Germany: Christoph Hoffmann, JKI (christoph.hoffmann@jki.bund.de)
France: Denis Thiéry, INRA (thiery@bordeaux.inra.fr)
Italy: Laura Mugnai, CNR-UNIFI (laura.mugnai@unifi.it)
Hungary: Viranyi Ferenc, SZIE (Viranyi.Ferenc@mkk.szie.hu)
Netherlands: Rien van der Maas, WUR (rien.vandermaas@wur.nl)
Chile: Mauricio Lolas Cuneo, Utalca (mlolas@utalca.cl)

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

This publication was funded by EU grant (Project number: 031499), under the Sixth Framework Programme, and is catalogued as Grapevine Case Study – Guide Number 3, published in July, 2010.

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

Bernard Blum, International Biocontrol Manufacturers Association; Laura Mugnai, CNR-UNIFI, Italy

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.

endure
diversifying crop protection

Food Quality and Safety
6TH FRAMEWORK
PROGRAMME

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.

For further information please contact:

Bernard Blum, International Biocontrol Manufacturers Association
> bjblum.ibma@bluewin.ch
Laura Mugnai, CNR-UNIFI, Italy
> laura.mugnai@unifi.it

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

This publication was funded by EU grant (Project number: 031499), under the Sixth Framework Programme, and is catalogued as Grapevine Case Study – Guide Number 4, published in July, 2010.

From Science to Field
Grapevine Case Study – Guide Number 5

New Resistant Grape Varieties

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

Sabine Wiedemann-Merdinoglu, INRA, France; Christoph Hoffmann, JKI, Germany

Clockwise from top left: Resistant varieties Regent, Felicia, Cabernet Carol and Johanniter.

endure diversifying crop protection

Food Quality and Safety
6TH FRAMEWORK
PROGRAMME

New resistant grape varieties

Following the introduction of three severe fungal diseases into Europe from America at the end of the 19th century, viticulture in Europe with traditional *Vitis vinifera* varieties has been impossible without considerable applications of fungicides. The first efforts in France to breed new fungus-resistant varieties by crossing resistant American *Vitis* species with traditional European *Vitis vinifera* led to hybrids which often produced an undesired off flavour. Thus for consumers, resistant varieties today are still associated with the off flavours of these hybrids and their poor wine quality. Only a few breeding stations in Europe continued with the work to cross back the hybrids with *vinifera* varieties to get resistant varieties with the traditional flavours that we are used to. In the meantime numerous new high quality/high resistance varieties not based on genetically modified organisms are available or in preparation in some countries. These new varieties are mostly unknown to consumers. They require only a small percentage of the fungicide applications that are necessary for cultivating traditional varieties. Thus their cultivation makes it possible to reduce drastically the number of sprays used in viticulture.

Prerequisites for the application of resistant varieties

> There must be a legal framework which allows resistant varieties to be planted.
> The viticulture in the region should not be identified by the consumer with specific traditional grape varieties (for example, Riesling in the Moselle region, Cabernet Sauvignon and Merlot in Bordeaux, Gewürztraminer in Alsace and Dolcetto in Piedmont).
> There should be a demand from growers and consumers to produce wine with fewer sprays.
> The grower must be convinced of the high quality of the wine produced by resistant varieties and must be able to sell it.
> There must be a market for the wines. This means consumers should be open to innovations. As the wine market is very traditional, changes or innovations in the wine business are not always welcomed even if they are a lot more sustainable than the traditional approach.

Factors affecting the efficacy of resistant varieties

> As for traditional varieties, resistant varieties should be adapted to particular *terroirs*. Here there is still a huge lack of experience which would enable possible adaptations to be identified.
> If a variety is resistant only to powdery mildew (*Erisyphe necator*) and downy mildew (*Plasmopara viticola*) but planted in an area with high disease pressure from other fungal diseases (for example, Black Rot, or Rotbrenner or Anthracnose) there may be disease outbreaks if the number of fungicide sprays is reduced.
> Pyramidized resistant genes from different resistance sources leads to more secure varieties than varieties with only one resistance gene.
> If the resistance is monogenic, it can be knocked out by some strains of the pathogens

Factors influencing the decision of growers to use resistant grape varieties

> Extensivation: The new varieties require reduced input of labour and reduce pesticide costs.
> The output question: Can the product be sold at an acceptable price?
> The quality of the wines.
> The protection of both the environment and the user from pesticides.
> The absence of pesticide residues in wines.
> A possible alternative in steep slope viticulture.

Bottlenecks for resistant grape varieties in different countries

	Chile	France	Germany	Hungary	Italy	Netherlands	Switzerland
Legal framework	No	Yes	No	No	Yes	No	No
Number of new registered resistant varieties	0	0	21	10	0	10	10
Number of new varieties registered as Vitis vinifera	0	0	21	0	0	8	?
Number of new varieties in registration process	0	0	15	?	0	0	1
% vineyard area with resistant varieties	0	0	<5	<10	0	>60	<5
Ongoing breeding programmes	No	Yes	Yes	Yes	Yes	No	Yes
Absence of consumer demand	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Absence of performance knowledge by producers	Yes	Yes/ No	No	No	Yes	No	Yes/ No
New varieties not known by consumers	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Nowadays, the new resistant varieties available have been bred in Germany and Hungary, and these resistant varieties are becoming increasingly well known among producers.

However, the legal situation in producer countries is varied. If we examine geographically protected wine systems, such as the AOCs of France and DOCs of Italy, the cultivation of these new resistant varieties is possible in Germany, the Netherlands, Switzerland and Hungary, while in France, Chile and Italy it is not.

And only in Germany and the Netherlands are new resistant breeds available which are classified as *Vitis-vinifera*-varieties. This means they can even be used even for quality wine production, while in other countries they can be used only for the production of table wines. It is important to highlight that in a new vine growing country, such as the Netherlands, these new resistant varieties are the ones that are most commonly planted and are well accepted.

In some countries, there might be a need for vinification knowledge for the new varieties. In countries such as Switzerland, Germany and the Netherlands, where the cultivation of resistant varieties is allowed, the bottleneck for their adoption in viticulture is probably the absence of a market for the wine. Wine is mostly made from traditional, well known varieties. And while winegrowers often have good knowledge of the newly bred varieties, consumer awareness of them, and their possible positive environmental impact, is low or non-existent.

This might sometimes be coupled with the belief among environmentally conscious consumers that organically produced traditional grape varieties are not sprayed at all. For example, in the Bordeaux region, organic viticulture is difficult to successfully manage because of the disease pressure resulting from the humid climatic conditions. In this case, the use of resistant varieties may perhaps be an alternative to traditional viticulture.

New resistant grape varieties

How to promote the dissemination of fungus-resistant grape varieties in Europe

The dissemination of resistant varieties is strongly influenced by the socioeconomic parameters of the market. The trends in wine consumption are not comparable to other products because of there is a lot of fuss made about wine.

> The legal framework needs to be adapted for each country.

> Target groups for new wines must be identified (for example, innovatively thinking young people with high environmental consciousness).

> Vinification experience with the new varieties should be more professionalised.

> Products with a perfect wine quality should be used to promote the new varieties, both towards consumers and winegrowers.

> Wines from resistant varieties should create a certain image which the target groups are looking for.

For further information please contact:

Switzerland: Pierre-Henry Dubuis, Agroscope ACW (pierre-henri.dubuis@acw.admin.ch)
Germany: Christoph Hoffmann, JKI (christoph.hoffmann@jki.bund.de)
France: Sabine Wiedemann-Merdinoglu, INRA (sabine.merdinoglu@colmar.inra.fr)
Italy: Laura Mugnai, CNR-UNIFI (laura.mugnai@unifi.it)
Hungary: Viranyi Ferenc, SZIE (Viranyi.Ferenc@mkk.szie.hu)
Netherlands: Rien van der Maas, WUR (rien.vandermaas@wur.nl)
Chile: Mauricio Lolas Cuneo, Utalca (mlolas@utalca.cl)

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

This publication was funded by EU grant (Project number: 031499), under the Sixth Framework Programme, and is catalogued as Grapevine Case Study – Guide Number 5, published in July, 2010.