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Development of monitoring schedules for grape diseases at regional scale

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Abstract: The ARD-VD is an association of wine growers, and both scientific and professional organisations. The association supports the implementation of integrated pest management and, in some demonstration vineyards, called "Vignobles de Reference®", different monitoring schedules are put into place. In order to optimise pest management, surveillance is carried out on climatic conditions, phenological growth stages and epidemiological development of insect pests and diseases. However, working at the individual farm scale clearly has its limits, such monitoring systems are time and energy consuming, and difficult to implement by the wine grower alone. So the decision was taken to evolve towards a larger regional scale aiming at the creation of local monitoring networks. This approach should lead to sharing the individual data and operating expenses, and to hiring extension workers dedicated to monitoring. These expenses will be covered by improved pest control and savings in spraying obtained trough the monitoring schedule.

Usually, in a "Vignoble de Reference®", our monitoring system combines a weather station, 'indicator plants' for primary contaminations of mildew, and several untreated small plots, focussing on the more sensitive sites. Transposing this protocol from farm scale to regional scale leads to various questions. In such a network the optimal density of measuring points must be adapted to the surface and topography of the region. This allows differentiating the main zones of differing sensitivity to pests and diseases and leads to adapt spraying locally.

To obtain some answers and to scientifically validate a monitoring system at this regional scale, a study was carried out this year. We monitored climate (four weather stations available), phenological growth stages, epidemiological development of mildew (ten sites with untreated microplots) and pest insects (40 traps) at the scale of the Buzet wine region.

This study revealed that one person is necessary to monitor approximately one thousand hectares (for both insects and diseases). Vigour and microclimate (soil, topography; landscape…) seem the main factors for sensitivity. Focussing the monitoring on 'fairly' to 'very sensitive' sites appeared the best choice, and the number of monitored sites (ten for diseases, 40 for insects in that region) seemed to be quite well adapted. On the other hand, the number of weather stations was clearly insufficient. We estimate that one weather station is needed per approximately ten square kilometres.

Key words: monitoring, regional scale, network

Introduction

The ARD-VD is an association whose aim is to support the implementation of integrated pest management as part of sustainable viticulture. It is composed of thirty-eight members. All stakeholders of the vine industry are represented: individual vine growers, groups of farmers, such as wine trade unions or cooperative wineries, distributors, agricultural suppliers (of pesticides, weather stations, spraying equipment), technical advisers, research institutes, and universities … Our purposes are to acquire, validate and spread knowledge and techniques needed to implement sustainable pest management. Demonstration vineyards, called "Vignobles de Reference®" (Bugaret, 2003), have been in operation since 2000 in France and Portugal. In these vineyards, we have validated monitoring systems and decision-making rules for several diseases (Bugaret & Bessard, 2002; Bugaret & Burosse, 2005; Burosse, 2004; Fulchin, 2005) at farm scale. These monitoring schedules consist of a detailed surveillance of:

- Phenological growth stages, particularly during the first stages in spring
- Epidemiological development of diseases by means of “indicator plants” for primary contaminations of mildew (specially trimmed vines, figure 1) (Coarer *et al.*, 2005) and of untreated microplots that are covered during pesticide applications
- Climatic conditions using a weather station. This allows us to use models for risk level prediction (especially for downy mildew) (Ducros *et al.*, 2005; Rouzet & Jacquin, 1995) and to optimise spraying schedules (first treatment and renewal).

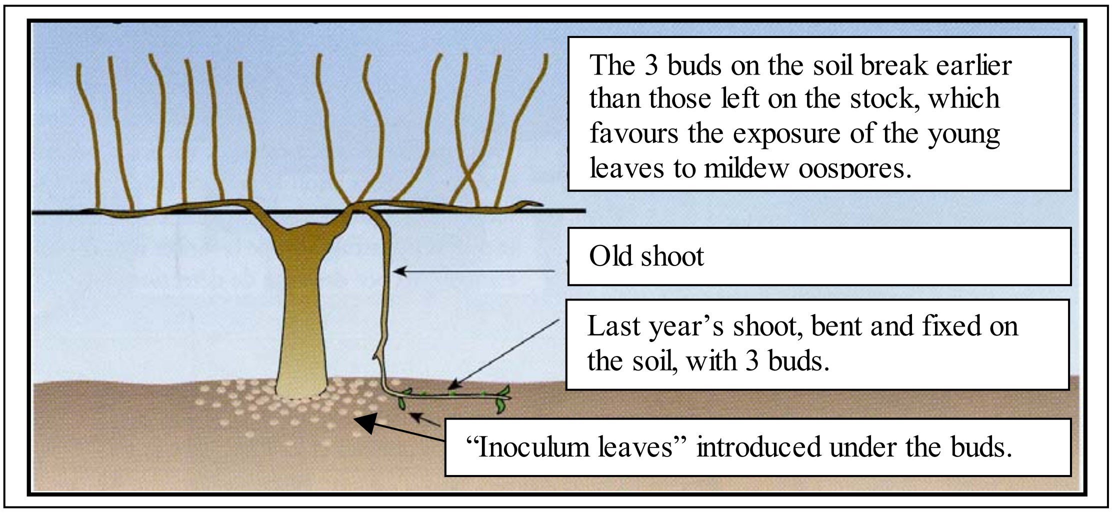

Fig. 1. The “indicator plant” method (Bugaret, 2001)

The sites chosen for surveillance were those identified as the most sensitive on the farm. Thanks to this monitoring system, we were able to reduce pesticide use by 20 to 30%. However, this device requires a lot of time and energy, and is very difficult to implement by the wine grower alone. At farm scale, it is not profitable for wine growers to pay a technician to carry out this monitoring: the costs are higher than savings made on sprayings. Moreover, the surroundings of the monitored plots are not taken into account. In order both to improve our methods and advice to be given, and to increase profitability for the wine grower, we decided to adopt a larger, regional scale and monitoring network. This implies working with groups of farmers (such as wine trade unions or cooperative wineries) who should collaborate in monitoring and share their individual data to compare different situations for sensitivity and risk. Even with the reduction of a single application, the savings in spraying do cover operating expenses that would be shared between all the wine growers of the network. These savings do also allow paying technicians or taking on workers dedicated to the monitoring (Table1).

At the individual farm scale, we normally focus on the more sensitive sites. But transposition to regional scale raises the issue of the optimal density of measuring points: how many monitoring sites are needed, and where should they be placed? Given the scale, we assumed that it was necessary to differentiate risk levels and implement monitoring in “fairly” to “very” sensitive sites. We therefore implemented a monitoring network at regional scale as part of an engineer work experience.

Table 1. Calculations of yearly expenses and savings due to monitoring of a 1000 ha network

EXPENSES		SAVINGS	
▪ Salary (1 master level graduate in agriculture) ▪ Operating expenses ▪ Investment 7 weather stations (amortized over 5 years) ▪ ARD-VD subscription (5€/ha)	35 000 € 4 000 € 6 000 € 5 000 €	▪ Average cost of a pesticide (diseases or insects) ▪ Average cost of 1 application (driver + equipment) Average cost of 1 spraying	25-30 €/ha 25-30 €/ha 50-60 €/ha
TOTAL (€)	**50 000 €**	**TOTAL (€)**	**50-60 000€**

Material and methods

The monitoring network was implemented by two master level students in agronomy from April to August 2007 (for their end of studies project report) in the South-West of France in the Buzet wine region. This region has a vine surface area of 2000 hectares distributed over 60 square kilometres. We monitored climate, epidemiological development of diseases and insect pests and phenological growth stages, in collaboration with the Buzet wine trade union.

Climate monitoring and modelling

Four weather stations were available, but only two were usable. The other two were badly situated. Four parameters were measured and recorded: air temperature, rainfall, air relative humidity and duration of humidity. The weather stations were checked twice a week by the ARD-VD. These parameters were then used for modelling the risk level of downy mildew using the POM (Prediction of the Optimum of Maturity of oospores) and EPI (Potential Infectious State) models created by the INRA (National Institute of Agronomic Research) (Tran Manh Sung *et al*., 1990).

Disease monitoring

This year’s climatic conditions clearly favoured the development of downy mildew in France. Hence our study focussed mainly on that disease. Ten plots were chosen throughout the wine region in “fairly” and “very” sensitive sites. The risk level was estimated by the wine growers according to the history of the plots. On each site monitored, two untreated microplots, covered during sprayings, were created in order to estimate mildew pressure and the sensitivity level of the site. Two other (treated) microplots were also defined so as to compare with the untreated ones and evaluate the efficiency of sprayings. These four microplots were observed once a week and symptoms on leaves and berries were noted by vine growth stages.

Insects monitoring

Forty ‘Tri Δnglué’ traps (Van Helden et al., 2008) for grape berry moths (*Lobesia botrana* and *Eupoecilia ambiguella*) and leafhoppers (*Empoasca vitis*, *Scaphoideus titanus*) were set up and observed twice a week: once by the students (every Monday) and once by the wine growers (every Thursday). Larvae were counted 3 weeks after trapping peaks.

Results and discussion

The exceptionally strong downy mildew pressure in 2007 made it harder than in the previous years to differentiate various sensitivity levels. However we observed that the monitored plots had different sensitivity levels to mildew. This must be confirmed by future studies. The choice of the two sensitivity levels "fairly" to "very" sensitive seemed appropriate but will also have to be reiterated later, especially during years with lower mildew pressure so as to confirm the observed sensitivity differences. But despite the observation of these differences, the sprayings could not be adapted locally this year: the slightest failure in protection would have had serious consequences.

"Indicator plants" for primary contaminations of mildew could not be used in this study. Such plants need to be prepared in autumn/winter of the previous year (collection of mildew inoculums, pruning) and the project was launched only in the spring. Indicator plants would have been the only way to adapt spraying locally this year by delaying or bringing forward the first application. One of the main improvements for future years' monitoring will be to include a network of "indicator plants" throughout the region, and especially to have one of these plants in each untreated microplot to monitor the first mildew cycles.

10 plots and 40 traps for diseases and insect pest monitoring seemed well adapted for the Buzet region, allowing differentiation of areas of different sensitivity. On the contrary, the number of weather stations was clearly insufficient. After meeting with experts on the subject, we estimate that one weather station is needed for approximately ten square kilometres.

Field observations required two days for the two students; data analysis required half a day and data capture with a GIS (Geographical Information System) two days. This led us to estimate that approximately one person is needed to monitor 1000 hectares. When comparing disease data with detailed plot information, several factors seemed to play a major role. Soil is clearly a factor of sensitivity, possibly through its influence on bud burst, vigour and physiology. In this region, three main kinds of soil are encountered, from sandy to limey clay. Vigour appeared to be a main factor of risk. Hence, monitoring one site for each combination soil-vigour might be a good way to differentiate sensitivity levels at regional scale. In the example of the Buzet wine region, three types of soil combined with three vigour levels (not very, fairly and very vigorous) would lead to nine different situations to monitor, which corresponds to the number of sites that seems appropriate. This appears to be a worthwhile path to explore.

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