Copper replacement in organic viticulture – state of the art in legislation and research

Ersatz von Kupferspritzungen im ökologischen Weinbau – Stand in Wissenschaft und Gesetzgebung

Beate Berkelmann-Löhnert∗

Abstract

In European viticulture, downy mildew (Plasmopara viticola (Bern. & Curt.) Berl. & de Toni) is one of the most damaging diseases affecting grapes, causing significant damage and severe decreases of product quality. European organic viticulture is predominantly based on copper applications to control this disease. Due to environmental problems incurred by copper applications, the European Commission decided to limit the use of certain copper products in organic viticulture. This should be achieved by the year 2002 (cf. EEC 1488/97). Therefore, the Commission recommends testing alternative strategies in downy mildew control in line with EEC 2030/91.

In the last decades, specific actions were realized to investigate, apply and support alternative control measures. These are based on microbial antagonists, plant extracts and organic, naturally occurring compounds. Studies on modes of action should help to characterize measures indicating effective resistance inducers.

Apart from the introduction of newly developed control agents, field trials focused on copper-reduction strategies and new products with extremely low copper concentrations. Nevertheless, a multidisciplinary approach is highly recommended in order to help solving one of the major problems of organic viticulture.

Keywords

Plasmopara viticola, ecoangiology, antagonists, plant extracts, systemic induced resistance, vitification, residues

Ecotoxicological aspects of copper applications

Agriculture in general and plant protection measures in particular are always characterized by deliberate intervention in ecological systems. The use of copper leads to particular environmental problems: besides the toxicity on water and soil organisms the substance is characterized to accumulate in the soil with high persistence properties (Müller, 2000). Aware of these environmental problems associated with copper, a number of national associations for organic viticulture, including Austria, Germany and Switzerland, limited the use of copper to 2–4 kg per ha and year. The copper application practice of other European countries is within any restriction (actual copper expense: 5–30 kg per ha and year). This inevitably leads to its accumulation in the soil and, subsequently, to an unacceptable pollution of the vineyards (Gätzl, 1987).

∗ The Gelsenheim Research Institute, Von-Lede-Str. 1, D-45366 Gelsenheim (Germany) bekelmann@lbs.gmx.de
Registered plant health improving agents and non-registered inorganic compounds

The efficacy of registered and accepted alternatives, so-called plant health improving agents like Umanus® and Myco-Sim®, is not always sufficient, especially when secondary infection cycles are strong and continuous and additionally overlapped by infectious soilborne oosporas, which germinate not only at the beginning of the growing period (primary infection) but several times during summer (Anonymous, 2000). Other agents of inorganic origin, such as phosphoric acid or polyphosphates, can serve as excellent control measures, but, thus far, not all of them have been yet discussed by European legislation for plant protection purposes in organic agriculture and viticulture. In addition, the use of phosphoric acid raises problems by virtue of an excess of phosphorous plant nutrition and also by some distinct residues in the wine (Spießer et al., 1993).

Concomitant research for alternative agents

Alternatives are given by the use of single biological agents or their combination. Such as microbial antagonists, plant extracts, inorganic substances, and naturally occurring compounds which can act antibiosis, parasitism, competition on space and/or nutrients and induced resistance as mode of action (Baker & Dunn, 1990). In the last decade fundamental research was conducted to isolate, characterize, and improve of antagonists on the one hand (Tischler, 1996) and of plant extracts on the other (Schmitt et al., 1995; Bieseler, 1999; Kast, 2001). In both cases, potential agents were found to control P. viticola with efficiency rates between 60 and 100% in a last disc bioassay and on potted vines. REM and microscopic studies on mode(s) of action indicated that sporangia germination as well as zoospore behavior were significantly affected. Over and above these studies will serve as basis to characterize markers indicating effective resistance inducers. This knowledge will allow targeted detection, combination and optimization of biological control agents (Deloire et al., 1998). However, due to an insufficient number of field trials and the lack of on-farm research only some of these biological agents have been further developed and/or exploited by organic wine growers.

Field tests and on-farm research

Problems arise when new agents are applied in the vineyard. Field tests for the assessment of effects and side-effects of newly developed agents have to be conducted on organic vineyards of research institutes according to European guidelines (cf. EPPO PP 1/31 [3]). For this purpose, biological agents require the addition of adjuvants or formulation additives in order to prevent or reduce disturbance by radiation, rapid degradation, and/or dehydroxylation. The addition of these substances has to be in line with the issue for the production of organic merchandise. Over and above, application with practically useful application facilities must be possible. The scale up from laboratory to field test level often causes problems with the required amount of biological compounds; this is especially true for plant extracts when application in high doses is required. In order to determine possible influences of the newly developed agents on fermentation, vinification and analyses of residues will be performed additionally.

Outlook

At the moment, the second and third step of the development of new agents seems to be the bottle neck and needs, therefore, special attention and support in future research proposals. It has to be stressed, that a multidisciplinary approach is highly recommended for the successful introduction of efficient alternative compounds selected from the extensive pool of agents isolated at laboratory level. In line with the directions of the 5th European Framework Programme (Quality of Life and Management of Living Resources) the extensive request by research has been expressed and proposed to the Commission in the year 2001 (proposal acronym: Plasmatol). If realized, the results of this European project will provide a valuable scientific base for Community legislation.

Literature Cited


