

Alternatives to copper-based treatments for the control of grapevine downy mildew (*Plasmopara viticola*): 5-year synthesis of trials in France and Italy



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introduction

In organic viticulture so far only copper can assure an efficient *Plasmopara viticola* (*P.v.*) control. However, many studies have demonstrated the **agronomical and environmental drawbacks** of **repeated copper spraying** in vineyards:

- copper **impacts soil organisms** and **accumulates in the soil** in the long term,
- a high soil copper concentration is **phytotoxic**, leading to potential decrease of yield.

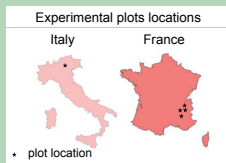
Copper use is currently limited to 6kg/ha/year by the European community. In the future, this **copper dose should decrease**.

The objective of the UE-funded program REPCO involving 6 european countries was to identify **new alternatives to copper fungicides** in organic farming. Some of the **most promising results on downy mildew control** are here presented.

experimental design

A **screening of 43 products** was firstly realised in a greenhouse to identify promising products.

The **efficiency against downy mildew of 39 alternatives** to copper formulations was **assessed in experimental plots** in South of France and North of Italy during the 2004-2008 period. Moreover, copper reduced-doses were tested.



Product efficiency was measured on leaf and bunches in July, August and just before harvest.

Results were expressed as leaf incidence, i.e. the frequency of leaves with at least one *P.v.* spot. The experimental design was composed of 4 repetitions of 12 plants per treatments.



Plasmopara viticola damages on leaf and bunch

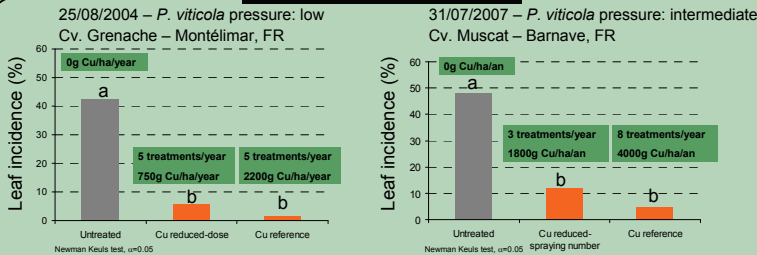
Example of products tested in experimental fields against downy mildew in France and Italy

Commercial name	Active ingredient
Untreated (reference)	
Champ DP	Copper hydroxide (37.5% Cu)
Kocide 2000	Copper hydroxide
Naturam 5	Copper peptidate
Labicuper	Copper gluconate (8% Cu)
Saporin	Yucca plant extract
Salix infusion	Salix plant extract
Inulex	Inula viscosa plant extract
Novosil	Abies sibirica terpenic acids
Timorex	Tea Tree oil
Timorex + Trapper	Tea Tree + organic fertiliser
Chitoplant	Shellfish chitin
Fosfidor	Potassium phosphonate
Armicarb	Potassium bicarbonate
Trichodex	<i>Trichoderma harzianum</i>
Sérénade	<i>Bacillus subtilis</i>
Clonoti	<i>T. harzianum</i> / <i>Clonostachys rosea</i>
Mycosin	Clay
Fertilfeuille	Lithothamne

The list of all the tested products is online at www.rep-co.nl website.

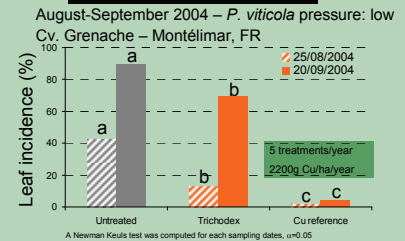
results & discussion

REDUCED-DOSE EFFICIENCY



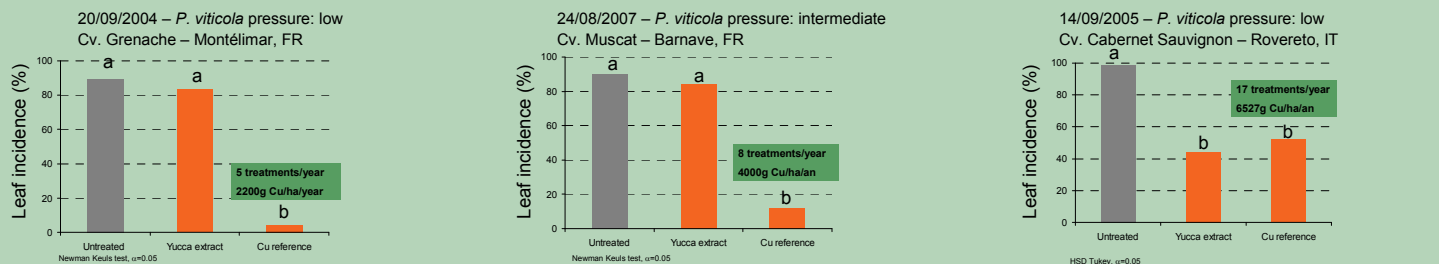
When *P. viticola* pressure is **low to intermediate**, a **reduction in the sprayed copper quantity** permitted by a lower sprayed concentration (left) or less copper treatments (right) provides the **same efficiency as standard strategies** and allows to **decrease two-fold to three-fold the sprayed copper quantity**.

ANTAGONIST EFFICIENCY



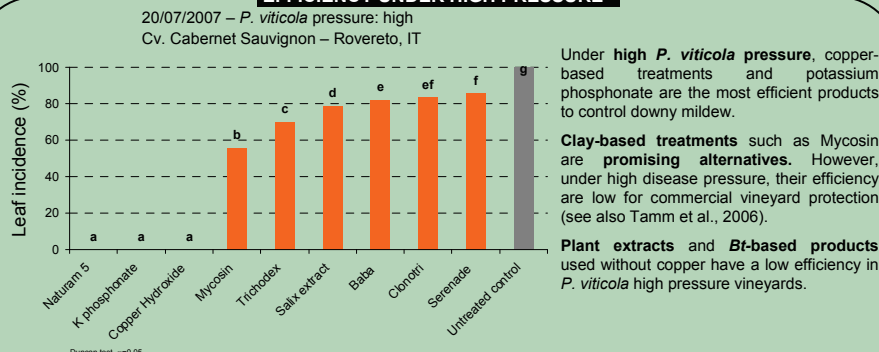
Among the tested **antagonists**, the **highest efficiency** was observed for ***Trichoderma harzianum*-based product**. Its efficiency was significantly higher than the untreated plot but decrease just before harvest. However, this *T.h.*-based product did not provide a level of *P.v.* control similar to copper in this trial.

PLANT EXTRACT EFFICIENCY



A **variability in Yucca extract efficiency** was observed **depending on the experimental plot**: no significant effect was observed in Montélimar (left) and Barnave (middle) sites whereas a significant effect was observed in Rovereto site (right) under a low *P. viticola* pressure compared to the untreated control.

EFFICIENCY UNDER HIGH PRESSURE



Under **high *P. viticola* pressure**, copper-based treatments and potassium phosphonate are the most efficient products to control downy mildew.

Clay-based treatments such as Mycosin are **promising alternatives**. However, under high disease pressure, their efficiency are low for commercial vineyard protection (see also Tamm et al., 2006).

Plant extracts and Bt-based products used without copper have a low efficiency in *P. viticola* high pressure vineyards.

→ The combination of both field experiments and screenings of a wide range of copper-alternatives is optimal to assess the efficiency of potentially interesting products.

→ Under *P.v.* high pressure, copper-based treatments are the most efficient.

→ Some alternative products gave promising results.

→ Further research is needed to identify other efficient alternative products when *P. viticola* pressure is high.