



Strategy for the minimisation of copper
in organic farming in Europe

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1 Introduction

This paper aims at presenting the organic strategy to minimise the use of copper in organic agriculture and at presenting existing minimisation activities in a number of EU Member States.

Copper is a trace element and an essential micronutrient appearing in plant, animal and human tissue. Therefore, copper is not only used in plant protection against bacterial and fungal diseases but also as a foliar fertilizer as well as a supplement in animal nutrition.

In the 1950s amounts of 20-30 kg/ha/year, exceptionally even 80 kg and more per hectare were applied for plant protection in Europe. Although copper formulations have been used for more than 100 years, there are no reported resistances which makes it a very important tool also in conventional and integrated pest management (IPM) farming systems.

Currently copper is approved as an active substance in plant protection product (PPP) for more than 50 different diseases in viticulture, horticulture, hops, market garden and arable crops. In particular, it is used for example in vineyards to control downy mildew (*Plasmopara viticola*), on arable crops to protect potato against late blight (*Phytophthora infestans*), in apple orchards to prevent the spread of scab (*Venturia inaequalis*) but also in many other crops.

2 The strategy of plant health care in organic farming

As a system approach to sustainable agriculture, organic farming aims to effectively manage ecological processes whilst lowering dependence on off-farm inputs. One of the main principles of organic production is the appropriate design and management of biological processes and natural resources which are internal to the agroecosystem with the aim of creating resilient agricultural systems.

Plant health is managed mainly through preventive and indirect measures such as the choice of appropriate species and varieties less susceptible to pests and diseases and adapted to the local conditions, appropriate crop rotation, the enhancement of functional biodiversity, the release of macrobials, mechanical and physical methods.

All these methods contribute significantly to enhance and further strengthen agro-biodiversity. Organic farmers play a key role in the development and the improvement of such measures. Mainly in speciality crops plant health care strategies consist of intelligent combinations of such measures with the use of naturally occurring substances as PPP.

Thus, the success does not depend only on the efficacy of the PPP itself but on the efficacy of the combined strategies.

The continuous improvement of these management systems with the aim of further reduction of the dependence of external substances is a substantial part of the organic farming reality.

3 Copper use in organic farming

Plant protection products containing copper are especially important in organic wine-, fruit-, hops-, potato-, as well as vegetables- and ornamental- plant production. Nevertheless, the minimisation of copper amounts applied is a central topic in organic farming and is therefore also reflected in the development of the organic regulation over time.

In the first European organic regulation in 1991¹ a maximum of 8 kg per hectare and year was allowed which was reduced in 2006 to 6 kg/ha/year. Under the current organic regulation (EC) No 889/2008² the 6 kg/ha/year was maintained.

Additionally, a smoothing mechanism of 30 kg/ha for five years is currently in place.

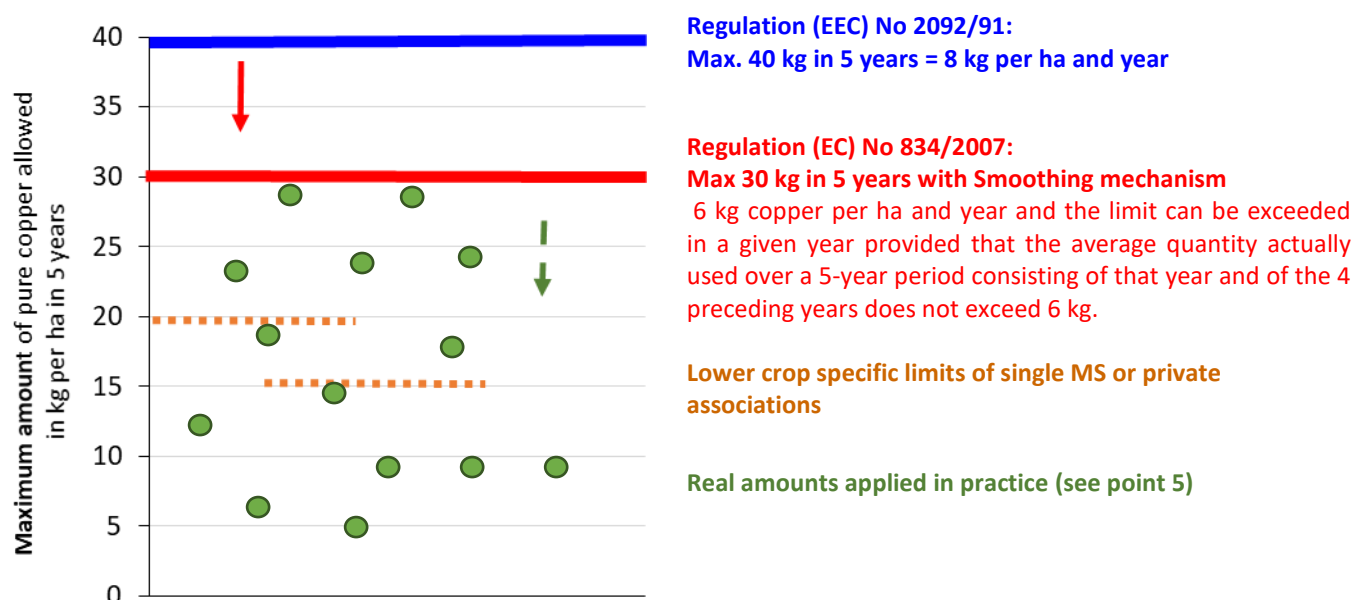


Figure 1 - Minimization of maximum amounts of copper allowed in organic farming until now (own figure)

In the last decade, considerable work has been done to further reduce the minimal amount of copper needed for successful disease control in organic farming. However, the success of this work especially in wine growing was set back by the fact that the overall duration of the vegetation period in the past years has considerably increased due to climate change. Thus, a higher number of applications per year is needed so that the progress in reduction of the amount of copper per application was nearly completely counterbalanced by the higher number of applications.

Regarding the use of copper in the minimization strategy in organic farming two special application characteristics must be explained:

¹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1991R2092:20080514:EN:PDF>

² <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R0889&from=EN>

Splitting

The application of copper compounds with amounts as high as registered are only used when severe infections are expected. Instead, in most cases copper is used with lower concentrations in combination with indirect measures and/or other products like for example Sulphur. Lower amounts per application imply also a lower risk for non-target organisms in the adjacent non-target areas.

Smoothing mechanism

For a successful copper minimization strategy, it is very important to motivate farmers to reduce copper in years with dry weather conditions. Only in years with very unfavourable weather conditions the full amount of copper allowed per ha and year is used. If the amount of copper allowed is defined for a period of five years, it is smart to apply a reduced amount of copper in regular years to have eventually more copper available in years with unfavourable conditions. This kind of regulation is contributing to the fact that only in few years and regions the full amount of copper allowed is used (see data in 5.).

4 The strategy of copper minimization in organic farming

The strategy to reduce copper in organic farming has two main aims:

- **Precautionary risk minimization** for copper as well as for other external inputs
- General **reduction of the dependence on copper** as well as on other external inputs and adaptation of plant health care strategies towards a better alignment to the basic principles of organic farming

This strategy consists of the combination of four components:

I. Use of alternatives

Replacement of copper with another substance which has the same unique properties and which is equally or even better "ecologically suitable" in terms of substance properties. This substance would need to have following characteristics:

- A significantly lower risk to health and the environment
- Be reliable and even with low application rates
- Have a high impact on many fungal and bacterial diseases
- Show no resistance in 100 years of practice

However, due to these unique properties of copper, it is unlikely that any new substance will ever be developed that fully comply with all these criteria.³

Therefore, alternative compounds would rather have to be many eco-compatible preparations that can completely cover the entire range of effects of copper stated above. Furthermore, it is very important for a sustainable development of the strategy to consider the properties of a total strategy

³ Andrivon D., Bardin M., Bertrand C., Brun L., Daire X., Fabre F., Gary C., Montarry J., Nicot P., Reignault P., Tamm L., Savinil., 2017. Peut-on se passer du cuivre en protection des cultures biologiques? Synthèse du rapport d'expertise scientifique collective, INRA, 66p. <https://inra-dam-front-resources-cdn.brainsonic.com/ressources/afile/423215-51d65-resource-expertise-cuivre-en-ab-synthese-francais.pdf>

resulting from such combinations in a culture- and application-specific manner and to put it in relation to the replacement of copper.

II. Lower application rates

- Optimisation of the application by improved use of forecasting models
- Reduction of the application rate by optimal application technology
- Reduction of the necessary amount of copper per application by better formulation of copper compounds in the product that allow lower application rates of pure copper with comparable efficacy.

III. Reduction of the dependency of pesticides by optimization and increased use of plant cultivation methods

- Management measures to reduce the infection potential of the diseases (e.g. remove infected leaves from orchards)
- Optimum soil care
- Adequate nutrient supply
- Optimal plant management in permanent crops to create a micro-climate that is unfavourable for fungi infections but promotes a good vigour for the crop (cut, leaf work, etc.)

IV. Reduction of dependence on pesticides through increased cultivation of resistant or robust varieties

The selection of fungal-resistant or tolerant varieties is an essential part in the strategy. However, the long-term sustainability of such a measure must be taken into account. In the short term, a regional monitoring of the development of resistances / tolerances of the available varieties must take place, in order to be able to estimate the development of the resistances and to be able to react accordingly. In the longer term, a broad genetic basis of resistance / tolerances is essential.

The combination of the four different components must be based on a system approach based on organic farming principles. Strategies in which, in addition to a precautionary risk minimization, a reduction in the dependency on pesticides is achieved, are particularly positive. Strategies leading to a reduction of dependence on pesticides are important not only in organic farming but can contribute to key European policies like the **Sustainable Pesticide Use Directive (SPUD)** and the currently elaborated EU strategy for non-toxic environment.

5 Copper minimization in organic farming in Europe

Activities at European level include projects funded under Horizon 2020 to reduce copper. Currently, there are numerous European activities in organic sector research on copper minimization in place focusing on optimized management systems and reduced copper use by combining different concrete strategies in line with the principles of organic farming (see previous point):

5.1 Activities at European level

CO-FREE Project: Innovative strategies for copper-free low input and organic farming systems, 2012 – 2016

The overall aim of the CO-FREE project was to develop copper free organic and low input production systems while maintaining yield and quality of crops and reducing negative environmental impacts.

As concluded in the final CO-FREE conference, immediate phasing out of copper would at present create unbearable risks and costs (e.g. for tools or risk compensation). Thus, phasing out of copper is currently not feasible generally. However, in the four systems under investigation in CO-FREE, further reduction is achievable in most crops, and possibilities are seen highest in potato>apple>tomato>grapevine.

In CO-FREE, depending on the crop, a range of measures were developed and are ready to be implemented and used, while others need some more time. For several of the alternative compounds investigated in CO-FREE, registration processes are expected to be complete at the earliest in 2022. Also, new varieties need time to be adopted by farmers, retailers and consumers, communication and commitment along the whole value chain being essential. Results indicated that strategies including the use of alternative compounds as one component together with Decision Support Systems, robust/resistant varieties and further measures will be the way forward to further reduce/replace copper. The most interesting alternative compounds will be tested for their suitability in practice in the RELACS project

RELACS Project – Replacement of Contentious Inputs in organic farming Systems, 2018 – 2022

Among other objectives, RELACS intends to provide alternative plant protection products with the aim to reduce or gradually phase out copper. These alternative products will be tested on the lead target crops grapevine and apple, and also on other horticultural crops by development of 4 alternative products with advanced Technology Readyness Level (TRL >7). All candidate products are far advanced, with proven activity under field conditions. They will be available in an advanced formulation for large-scale field trials.

5.2 Activities in the Southern zone

5.2.1 Italy

In Italy there is currently no maximum level for the amount of copper to use per ha and year in the national authorization. However, there are limits for different products based on copper compounds. In organic farming, the limits of the Regulation (EC) 834/2007 are in force at national level. Several private organisations, especially the international organisations (Naturland, Demeter) and the Bioland association active in South Tyrol have lower limits (in general 3 kg ha and year). In the southern part of Italy the amount of copper compounds used by the growers is very low also in crops which traditionally use high amounts of copper like vineyards depending on the climate conditions in spring. In the typical northern regions (Piedmont, Friuli) famous for the excellent wines and important fruit industry, rainfall during the vegetation period is quite frequent and often severe. In these conditions 6 kg of copper per ha and year is often needed to protect efficiently the harvest from *Plasmopara viticola* and other disease.

There were different research projects and activities of farmers to minimize copper application:

- **STU.LI.RA. (Studies to comply with the limitations on copper quantities through the use of low-dose formulations or alternative means).** This project was supported by the Italian Ministry of Agriculture, Food and Forestry Policies and led by the Plant Pathology Research Centre in Rome.
- **PRO.VI.SE.BIO (2009-2011) Vine and seed protection in organic farming.** This project was supported by the Italian Action Programme for Organic Agriculture and Organic Products. It was divided into 2 subprojects: Organic Viticulture, to identify strategies to reduce or replace the use of copper for grape downy mildew and Organic Seeds.
- **Bio Bug Bang (2010-2012) (Bioformulations with antimicrobial activity).** This project was supported by the Italian Action Programme for Organic Agriculture and Organic Products (Action 2.2).
- **[ALT.RAMEinBIO \(2015-2018\) \(Reduction strategies and possible alternatives to the use of copper in organic farming\).](#)** This project was supported by the Italian Ministry of Agriculture, Food and Forestry Policies (MIPAAF), under an agreement signed by the Council for Research in Agriculture and the Analysis of the Agricultural Economy (CREA) and MIPAAF. A follow-up project is currently under construction.

In the frame of the project “AltRameinBio” representatives of organic farming (FIRAB), Universities and different local experimental stations (FEM, RC-Laimburg) coordinated by the national institute for Plant protection CREA DC meet once a year to exchange experience and results and to discuss progress. The main topics are development and validation of decision support system for disease management in wine grape production, reduction of copper amounts per treatment, comparison of different copper formulations, alternative products based on plant extracts, microorganism etc., rain cover systems for permanent crops. In all these cases, the comparison of the ecological effects (including life cycle analysis) of the copper use and the alternatives is still discussed. The breeding and the testing of varieties tolerant or resistant to the most important diseases is another important topic in the minimization strategy.

All these parts of a minimization strategy currently are not yet developed far enough to be implemented successfully in practice.

5.2.2 France

The national legal allowed application rate of copper is 6kg/ha/year with smoothing mechanisms (30 kh/ha/year) for organic agriculture. Private labels can be lower: e.g. [Demeter](#) allows 3kg/ha/year with smoothing.

The amount of copper actually used in France as PPP in organic farming varies a lot from a region to another, from a year to another. In 2013, the French Organic Research Institute (ITAB), the French Wine Institute and professional organisations have published a survey⁴ on 5 years of use of copper by organic winegrowers from 2008 to 2012. 2008 and 2012 have been years with bad weather conditions. Around 500 winegrowers have answered. Here are the results, region by region:

⁴ See : <http://www.itab.asso.fr/downloads/com-intrants/dossier-cuivre-en-ab-dec2013.pdf>

Résultats de l'enquête viticulture sur les 5 derniers millésimes

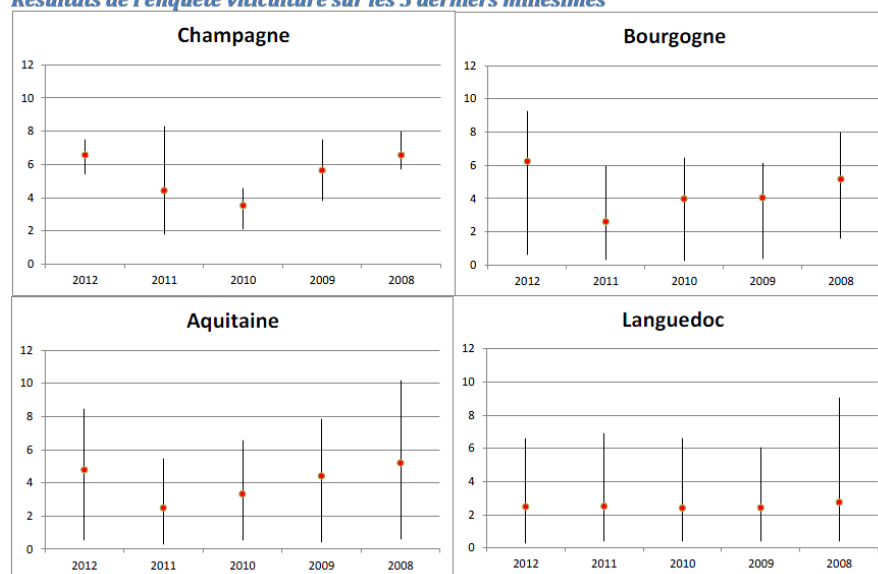


Figure 2 – Minimum and maximum of copper application 2008 – 2012 in kg/ha per year in different French regions. The red point is the average

The graphic shows that the amount used varies a lot and furthermore it is displayed how the smoothing mechanism works. It also shows that producers use more than 4kg/ha/a in 4 years out of 5 in Champagne 3 in Aquitaine, 2/5 in Burgundy and the least dependent is the Mediterranean area, Languedoc Region.

In France, there is no regular meeting of a copper task force as in Germany (see point 5.3.1). However, professional agricultural associations organise common meetings with the ministries to inform the government regularly. A common document paper has been written and given to the government

General pesticide reducing strategy has been settled in France through a national program called “Ecophyto”⁵. The aim is to reduce the use of all kind of pesticide in agriculture. This program helps to finance research projects, trials, but also the animation of the small groups of producers at the local level. These groups of producers meet regularly, test together solutions and organise field visits.

Organic farmers are active in the frame of this programme working on the copper minimization strategy.

5.3 Activities in the Central zone

5.3.1 Germany

In the current national authorization of copper compounds in Germany the application of copper is restricted to 3 kg/ha/year (4 kg/ha/year for hops). The private associations of organic farming have always restricted copper applications to 3kg/ha/year (4 kg/ha/a for hops). The biodynamic association Demeter does not permit copper application except than for permanent crops.

However, for organic wine, in the last years it became evident that in difficult years and with the current availability of PPP for organic wine growing, 3 kg/ha/year has proved not to be sufficient for an effective control of fungal diseases in all regions.

⁵ <http://agriculture.gouv.fr/le-plan-ecophyto-pour-reduire-lutilisation-des-produits-phytosanitaires-en-france>

Copper minimization has always been an important issue in organic farming in Germany. When due to the Commission Directive 2009/37/EG of 23 April 2009 Member States (MS) had to pay particular attention to the amount of the copper applied and ensure that the authorised amounts, in terms of rates and number of applications, are the minimum necessary to achieve the desired effects. In order to give structure and transparency to these objectives the German organic farming associations signed a comprehensive [copper minimisation strategy paper](#) in March 2010.

Conventional fruit, hops, and wine production are also integrated in the strategy represented by the respective farming and grower associations. In the strategy paper, the organic farming sector expressed the needs for research and development for a successful copper minimisation. In consequence, from 2010 to 2017 36 research projects for copper minimisation were funded by the Federal Ministry of Food and Agriculture (BMEL) in the frame of the BOELN with a total amount of 9,7 million €.

As part of a detailed copper minimisation strategy the German organic farming associations started an intensive monitoring of the amounts of copper actually applied for plant protection in different crop species in the practice of organic farming. The data is published in the [updated paper of October 2015](#) where also the progress of the strategy was documented.

Progress was achieved in the reduction of the amount of copper per application in different crops leading to a reduction of the risk for non-target organism in surrounding areas. However, the success of this work was set back by the fact that the overall duration of the vegetation period in the past years has considerably increased due to climate change. Thus, especially in vine growing a higher number of applications per year is needed so that the progress in reduction of the amount of copper per application was nearly completely counterbalanced by the higher number of applications. In fruit growing, other minor diseases appeared (e.g. *Marssonina coronaria*) and the resistance of the scab resistant varieties – an important part of the strategy - was broken. Until now, there is uncertainty regarding the availability of some alternative compounds that are also important parts of the strategy.

Part of the structured minimisation strategy is an annual meeting in autumn organized by the German Association of Organic Farmers, Food Processors and Traders (BOELW) in collaboration with the Federal Research Centre for Cultivated Plants (JKI) where the German organic associations present updated monitoring data and the “state of the art” of the minimisation process in place to the German authorities. The Federal Ministry of Food and Agriculture (BMEL), the Federal Office of Consumer Protection and Food Safety (BVL), the German Environment Agency (UBA) and the Federal Office for Food and Agriculture (BLE) participate in the meeting. Furthermore, the meeting brings together state actors, farming associations and researchers for an overall update on the current situation of the copper minimisation strategy in Germany.

In the past two years, this annual meeting developed into an international conference with the participation of authorities, researchers and organic associations from several EU Member States and IFOAM EU experts.

The following table is a summary of the monitored average amounts in kg copper/ha/year in German organic farming. The average is taken only from areas and organic production actually treated with copper and do not represent an average over the entire organic cultivated area.

Table 1: Average amounts of copper used in German organic farming in the years 2010-2015

Crop	2010	2011	2012	2013	2014	2015
Fruit						

Apple	1.59	1.3	1.31	1.47	1.49	1.51
Pear	1.49	1.1	1.26	1.07	1.12	1.44
Peach	2.21	1.9	2.0	1.7	n/a	n/a
Stone fruit	1.28	0.94	0.99	0.83	1.05	1.2
Berries						0.23
Strawberries						0.98
Horticultural Crops						
Celery	2.32	1.1	0.85			1.25
Pumpkin	1.8	2.1	1.4	0.36	0.98	1.48
Cucumber	1.43					
Fennel		0.9				
Leek		3.0				
Asparagus		2.0	1.2	1.09	0.92	1.27
Carrots						1.5
Onion				0,85	2.17	1.63
Green house		1.4	1.3			
Arable Crops						
Potato	1.36	1.6	1.87	1.38	1.54	1.50
Wine						
Wine	2.23	1.98	2.34	2.29	2.42	1.85
Hops						
Hops	3.9	3.7	3.6	2.6	3.3	1.5

In the data presented in the strategy paper of the German organic farmers associations it is also shown that the percentage of area where the maximum amount of copper allowed is used depends very much of the year and is rather low: In wine growing, in 2011 ca. 15 % of the area in investigation was treated with more than 2.5 kg. In 2012 and 2013 with more unfavorable weather conditions this area was more than doubled to about 30 %. In fruit, the area treated with more than 2.5 kg/ha/year is varying also, normally it rates about 10 % of the area in investigation or even less.

5.3.2 Austria

In Austria, at national level a maximum amount of copper of 6 kg/ha/year is allowed in organic farming. The organic farming association Bio Austria sets considerably lower levels that are also crop-specific: 3 kg/ha/year in wine growing and fruit, 2 kg/ha/year in arable crops and 4 kg/ha/year for hops. The second relevant organic association Erde & Saat⁶ allows a maximum of 2 kg/ha/year with the exception of wine growing where it is 3 kg/ha/year.

⁶ <https://www.erde-saat.at/unterlagen-und-formulare/erde-saat-arbeitsweise/>

Organic farming associations participate in the [copper task force](#) set up by the Austrian Agency for Health and Food Safety (AGES) in May 2014 with the common aim to minimize the use of copper. It consists of the different sector groups as well as of conventional and organic farming associations and industry representatives. It organizes a national event once a year in order to bring together different constituencies involved (conventional/organic farming associations, researchers, policy makers) and discuss the national copper minimization strategy.

In the course of the task force work the biannual copper project was conducted from 2010 – 2012 about the use of copper as plant protection product in Austria and strategies for a sustainable use. A comprehensive soil investigation program and the risk assessment for the terrestrial ecosystem has been carried out within the project. It has shown that there is no significant difference between organic and conventional agriculture concerning the soil concentration.

Currently the University of Natural Resources and Life Sciences Vienna as well as the Federal College and Research Institute for [Viticulture and Pomology Klosterneuburg](#) have research projects for copper minimization in wine- and fruit growing in place where possible copper alternatives and viable copper minimization strategies are tested. However, the results currently are not yet developed far enough to be implemented successfully in practice.