

High levels of copper and persistent synthetic pesticides in vineyard soils¹

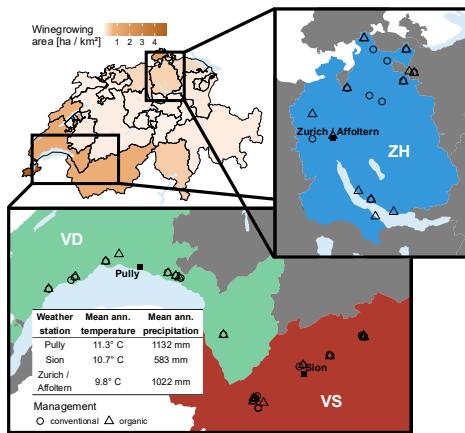
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Introduction

The excessive use of pesticides in viticulture, representing 58% of fungicide use in agriculture², has led to their widespread accumulation in vineyard soils. The aim of this study was to representatively assess pesticide contamination of Swiss vineyard soils and estimate their potential risks.

Methods



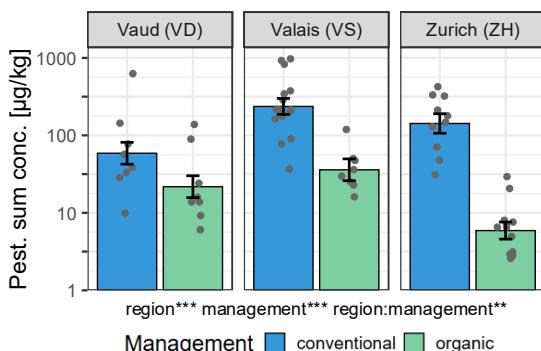
Investigation of 62 conventional & organic vineyards in three major winegrowing regions

- Separate sampling of vine row & inter-row as well as surface (0-5 cm) & subsurface (5-20 cm) soils
- Highly sensitive quantification of 146 pesticides & transformation products (QuEChERS & LC-MS/MS)³
- Total copper analysis (HNO₃-Extraction)
- Risk assessment using toxicological data from literature

Results

Synthetic pesticides & transformation products:

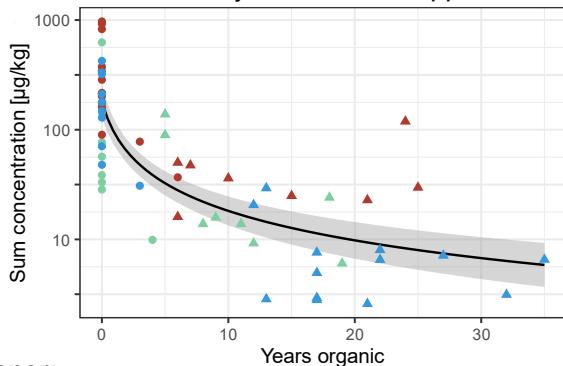
- Up to 60 different pesticides in conventional & 32 in long-term organic vineyards (>20 years) detected
- Clearly higher contamination in conventional vs. organic and regional differences
- Strong within-field heterogeneity (surface >> subsurface, vine row > inter-row)



Conclusions

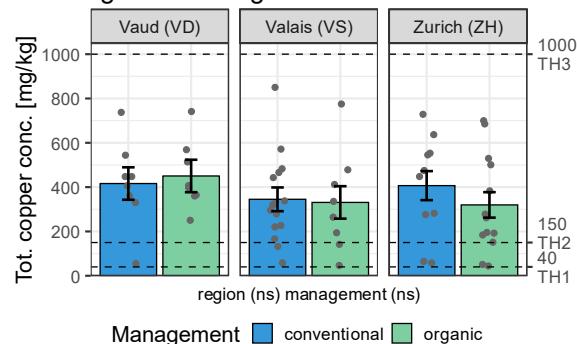
Synthetic pesticides are ubiquitous in Swiss viticultural soils, including long-term organic vineyards. Potentially risky concentrations were reached mainly in conventional farming, while copper contamination was uniformly high in most researched vineyards. Viable alternatives are needed to alleviate this “double threat” to soil organisms.

- Clear decrease with years after last application



Copper:

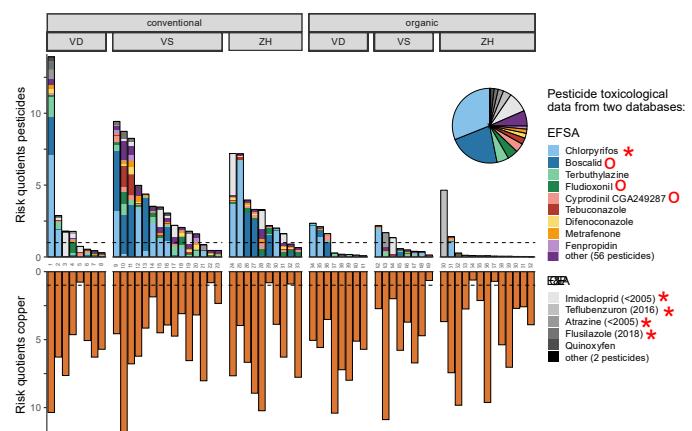
- Generally high contamination of up to 850 mg/kg total copper
- No management or regional differences



- Governmental thresholds of 150 mg/kg exceeded in most vineyards (dashed line)

Risk Quotients (RQ):

- Potentially risky concentrations frequently found for cumulated risk quotients & for some single substances
- Many pesticides are currently banned (*), but still remain present in the soil
- Copper and botryticides (○) have very high RQs



¹Barmettler et al. Double the trouble: High levels of both synthetic pesticides and copper in vineyard soils (2025) Environmental Pollution 375. <https://doi.org/10.1016/j.envpol.2025.126356>

²Federal Office of Agriculture. Agrarbericht 2024 (2025).

³Rösch et al. A multi-residue method for trace analysis of pesticides in soils with special emphasis on rigorous quality control. Anal. Bioanal. Chem. (2023) 415:6009–6025. <https://doi.org/10.1007/s00216-023-04872-8>



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