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Cocktails of pesticide residues in conventional and organic farming systems in Europe – legacy of the past and turning point for the future

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Considering that pesticides have been used in Europe for over 70 years, a system for monitoring pesticide residues in EU soils and their effects on soil health is long overdue. In an attempt to address this problem, we tested 340 EU agricultural topsoil samples for multiple pesticide residues. These samples originated from 4 representative EU case study sites (CSS), which covered 3 countries and four of the main EU crops: vegetable and orange production in Spain (S-V and S-O, respectively), grape production in Portugal (P-G), and potato production in the Netherlands (N-P). Soil samples were collected between 2015 and 2018 after harvest or before the start of the growing season, depending on the CSS. Conventional and organic farming results were compared in S-V, S-O and N-P. Soils from conventional farms presented mostly mixtures of pesticide residues, with a maximum of 16 residues/sample. Soils from organic farms had significantly fewer residues, with a maximum of 5 residues/sample. The residues with the highest frequency of detection and the highest content in soil were herbicides: glyphosate and its main metabolite AMPA (P-G, N-P, S-O), and pendimethalin (S-V). Total residue content in soil reached values of 0.8 mg kg⁻¹ for S-V, 2 mg kg⁻¹ for S-O and N-P, and 12 mg kg⁻¹ for P-G. Organic soils presented 70-90% lower residue concentrations than the corresponding conventional soils. There is a severe knowledge gap concerning the effects of the accumulated and complex mixtures of pesticide residues found in soil on soil biota and soil health. Safety benchmarks should be defined and introduced into (soil) legislation as soon as possible. Soil remediation techniques should be developed to keep the levels of pesticide residues below such benchmarks. Furthermore, the process of transitioning to organic farming should take into consideration the residue mixtures and their residence time in soil.