



# The division of Europe into regions with similar potential effectiveness and environmental consequences of pesticide application based on expert inclusive research



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## ABSTRACT

A division of Europe into regions with similar climate and soil conditions, assuming similar pesticide effectiveness and environmental effects of their application, was developed by a combination of statistical cluster analysis and expert involvement for identifying clustering variables and weighing their importance. The experts identified 15 variables representing climatic, soil and crop structure data and weighted them. In order to maximally simplify the administrative work with pesticide registration resulting from the division of Europe into zones, the additional criteria in the procedure were: the zoning follows existing administrative borders, country divisions by zone boundaries are limited, and situations where a zone consists of parts separated by another zone are avoided. The results of the analyses were compared with the applicable EPPO classification and visualized on maps. The highest similarity was observed in the southern Mediterranean zone, the layout of which differed by only a few regions. The Alpine part, having specific conditions, was not distinguished among the EPPO zones. Our study very clearly delineated the Central European part, having a climate with continental influence, which is distributed among other zones in the EPPO classification.

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## 1. Introduction

One of the most important characteristics of natural conditions describing geographic regions is their continuity. It concerns, in particular, climate and soil properties, or the structure of natural vegetation habitats. It is manifested by the lack of sharp, clear boundaries, or the existence of zones where different, spatially dispersed habitats interpenetrate. The only exception where distinct zonation of both the climate and the vegetation can be observed are mountain areas. At the same time, there is a need for the classification of areas characterized by diverse natural conditions, due to the necessity to assign to them generally recognized names for administrative or other practical reasons. The contradiction between the need for classification and the continuity of nature properties is usually overcome by adopting arbitrary divisions on the basis of a compromise between different concepts.

An obvious example of the above problem is the division of Europe into regions characterized by climate and soil conditions which are similar enough to ensure that the evaluation of pesticide

efficacy and the assessment of the environmental effects of their application will be relevant for the entire region. The legal basis for such an analysis is provided by the Regulation (EC) No. 1107/2009 of the European Parliament and of the Council of 21 October 2009 (EU, 2009) concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC (Official Journal of the European Union L309 page 3 (29)):

“... authorisations granted by one Member State should be accepted by other Member States where agricultural, plant health and environmental (including climatic) conditions are comparable. Therefore, the Community should be divided into zones with such comparable conditions in order to facilitate such mutual recognition”.

Because of practical reasons connected with the necessity to maximally simplify further administrative works, such a division has to meet additional criteria, which are not usually taken into account by naturalists. They include a need to base the division on the existing administrative borders, to limit country divisions by zone boundaries, or to ensure coherence of the zones (avoid situations where a zone consists of parts separated by another zone).

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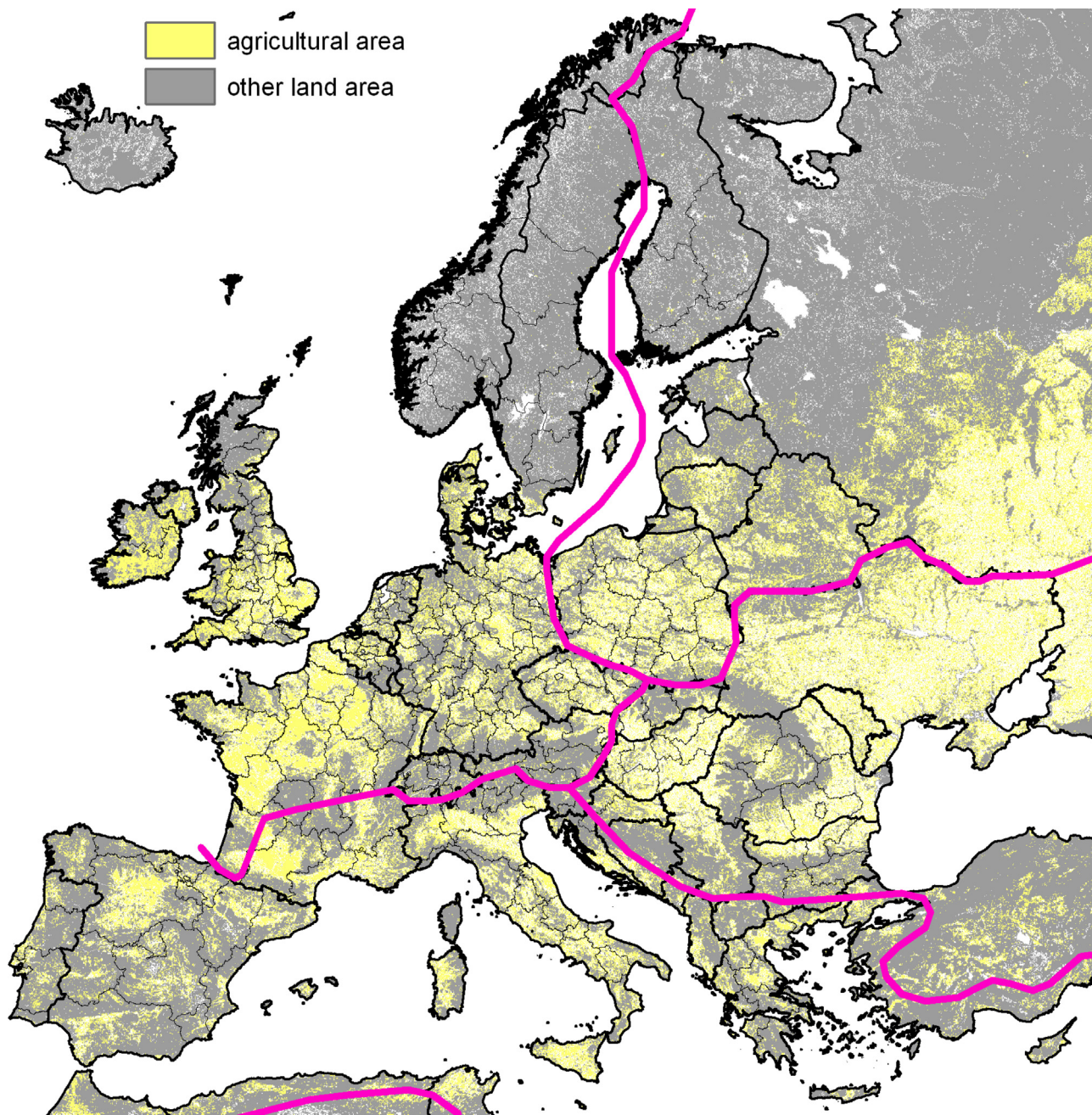


Fig. 1. Agricultural land distribution in Europe and EPPO division into climate zones. (Source: EPPO Standards PP1/241(1)).

At present, the problem has been partly resolved by the adoption of the division of Europe into four zones (Fig. 1) proposed by the European and Mediterranean Plant Protection Organization (EPPO)—an intergovernmental organization responsible for cooperation activities in the area of plant protection in Europe and in the Mediterranean region. The division into climate zones according to the EPPO has been conducted on the basis of a comparative analysis (Bouma, 2005) of agro-climatic classification systems, particularly climate diagrams (Walter and Lieth, 1960), climate classification systems (Köppen and Geiger, 1936; Thran and Broekhuizen, 1965) and natural vegetation maps. The analysis did not include mountain areas above an altitude of 1000 m.a.s.l.

Unfortunately, the methodology applied by the EPPO in the classification of the zones takes into account only climatic factors, whereas the list of key factors contained in the EPPO working document “Efficacy evaluation of plant protection products” (EPPO 11/16945) includes also crop structures and soil properties, such as texture, organic matter content and moisture. Moreover, the choice of the climatic classification systems is arbitrary, because of the existence of many such systems. Therefore, it is necessary to develop a methodology of zonal classification that will take into consideration the neglected soil factors and minimize the impact of arbitrariness. An alternative method which meets the above conditions is a classification procedure, widely used in statistics,

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