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VitisCLIM, a project modelling epidemiology and economic impact of grapevine 'flavescence dorée' phytoplasma in Austrian viticulture under a climate change scenario

Robert Steffek[1], Helga Reisenzein[1], Gudrun Strauss[1], Thomas Leichtfried[1], Johannes Hofrichter[2], Ian Kopacka[2], Michael Schwarz[2], Josef Pusterhofer[3], Reinhold Biedermann[3], Wolfgang Renner[3], Josef Klement[4], Werner Luttenberger[4], Alexander G. Welzl[5], Anna Kleissner[5], Raimund Alt[5]

[1]*Austrian Agency for Health and Food Safety, AGES, Institute of Plant Health, Vienna, Austria*
[2]*Austrian Agency for Health and Food Safety, AGES, Business Area of Data, Statistics and Risk Assessment, Graz, Austria*
[3]*Amt der Steiermärkischen Landesregierung, Amtlicher Pflanzenschutzdienst, Graz-Ragnitz, Austria*
[4]*Landwirtschaftskammer Steiermark, Graz, Austria*
[5]*Economica Institute of Economic Research, Vienna, Austria*

Abstract

Climate warming allows invasive pests to establish in areas where they have not been recognized before. Since its introduction in the 1950's in southern France, grapevine 'flavescence dorée', a quarantine disease of grapevines, has spread significantly in Europe and has first been detected in Austria in the southeast of Styria in autumn 2009, which currently marks the Northeastern border of its extension. VitisCLIM, a project funded by the Austrian Climate and Energy Fund, started in April 2011 and aims to model the current and future potential distribution of the disease and its vector, the leafhopper *Scaphoideus titanus*, in Europe under the influence of climate change. Vine growing areas of high risk in Austria will be defined. Based on scientific literature and empiric studies, an epidemiological model will simulate the temporal and spatial dynamics of the spread of the disease and its vector. Sensitivity analysis will determine critical parameters, including different management strategies which have an impact on the dynamics of the spread. The spread model, together with the results of a survey on direct and indirect costs will then be used in Input-Output Analysis to model the potential economic impact of 'flavescence dorée' to Austrian viticulture and related economic sectors. The results of the project will be communicated to stakeholders, risk managers, policy makers.

Key words: *Scaphoideus titanus*, grapevine yellows, CLIMEX®, climate warming, spread, spatial analysis, sensitivity analysis, economic impact assessment.

Introduction

Grapevine 'flavescence dorée' (FD) is a severe disease of grapevine. The associated organism is of quarantine concern in Europe according to EC directive 2000/29. It is transmitted by its principal vector, the nearctic leafhopper *Scaphoideus titanus*, which was introduced from North America and reported for the first time in Europe in the late 1950s in vineyards of South-West France (Schvester *et al*., 1963). Since its first finding in Austrian vineyards in 2004 the vector of FD has spread and is now established in parts of Styria (Zeisner, 2009). FD was recorded for the first time in Austrian vineyards in 2009.

At the northern border of its range short summers prevent the further spread of *S. titanus*, since the vector has difficulties to complete its development and may therefore only form transient populations. Climate change with longer and warmer summers would consequently favour the spreading of the vector further to the north by extending the favourable developing season (Boudon-Padieu and Maixner, 2007).

By including the effect of different climate change scenarios, the project aims to investigate the establishment potential of the disease and its vector in Central Europe, particularly in Austria's main vine growing regions in the north (Lower Austria and Burgenland). This data will be further used to develop models on the spread dynamics of GFD and on the impact to Austrian economy.

Materials and methods

Mapping establishment potential

The CLIMEX® software will be used to model *S. titanus*' establishment potential. Data on its current distribution will be assembled by a systematic literature search to determine the parameter setting. The vectors sensitivity to climate change will be analysed by testing different climate change scenarios based on the results of the IPCC (2007). The generated distribution maps for *S. titanus* will be combined with land use data of the vine production area in Austria and the European Union applying ArcGis.

Modelling spread dynamics

A model to simulate the dynamics of the natural spread of FD in an area will be developed. This model will be based on monitoring data of the distribution of FD and *S. titanus* in Austria and on information on population dynamics and movement behaviour of the vector. The model will be tested using spread data from recent outbreaks and applied to high risk areas as defined during mapping of the establishment potential. Different risk management options will be incorporated in the model and evaluated with respect to their efficiency in containing the disease. Sensitivity analysis will determine critical parameters which have a major impact on the dynamics of spread.

Modelling economic impacts

The economic impact model will use Input-Output Analysis (IOA), which is a methodical instrument to record the mutually linked supply and demand structures of the sectors in an economy and to quantify the overall economic effect. It analyses direct effects and multiplier effects which are applied to different scenarios, of risk management strategies and climate change. The results of the Input-Output-Analysis may finally be compared to the costs of applied measures and activities. In this way an advanced approach of measuring impacts against inputs and costs of a plant pest will be provided.

The results of the project will be discussed in a participative dialogue with stakeholders and scientists and can be used by risk managers and policy makers as basis for their decisions.

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Corresponding author: Robert STEFFEK (e-mail: Robert.steffek@ages.at), Austrian Agency for health and food safety, Vienna, Austria.