

Ubiquitous *Phytophthora* infestations of nurseries and plantings in Europe demonstrate major failure of plant biosecurity

T. Jung^{123*}, L. Orlikowski⁴, B. Henricot⁵, P. Abad-Campos⁶, A.G. Aday⁷, O. Aguin Casal⁸, J. Bakonyi⁹, S.O. Cacciola¹⁰, T. Cech¹¹, T. Corcobado², A. Cravador³, G. Denton⁵, S. Diamandis¹², H.T. Dođmuş-Lehtijärvi⁷, B. Ginetti¹³, J. Hantula¹⁴, G. Hartmann¹⁵, M. Herrero¹⁶, A. Lilja¹⁴, M. Horta³, N. Keca¹⁷, V. Kramarets¹⁸, A. Lyubenova¹⁹, H. Machado²⁰, G. Magnano di San Lio¹⁰, P.J. Mansilla Vázquez⁸, B. Marçais²¹, I. Matsiakh¹⁸, I. Milenkovic¹⁷, S. Moricca¹³, J. Nechwatal²², T. Oszako²³, A. Pane¹⁰, E.J. Paplomatas²⁴, C. Pintos Varela⁸, C. Rial Martínez⁸, C. Robin²⁵, A. Rytönen¹⁴, M.E. Sánchez²⁶, B. Scanu²⁷, A. Schlenzig²⁸, J. Schumacher²⁹, A. Solla², E. Sousa²⁰, V. Talgø¹⁶, P. Tsopelas³⁰, A. Vannini³¹, A.M. Vettraino³¹, M. Wenneker³², A. Pérez-Sierra⁶

1Phytophthora Research and Consultancy, Thomastrasse 75, D-83098 Brannenburg, Germany.

2Ingeniería Técnica Forestal, Universidad de Extremadura, Avenida Virgen del Puerto 2, 10600 Plasencia, Spain.

3Center for Mediterranean Bioresources and Food (MeditBio), Laboratory of Molecular Biotechnology and Phytopathology, University of Algarve, Campus de Gambelas, 8005-139 Faro, Portugal.

4Institute of Horticulture, Konstytucji 3 Maja 1/3, 96-100 Skierniewice, Poland.

5Royal Horticultural Society, Wisley, Woking, Surrey GU23 6QB, UK.

6Grupo de Investigación en Hongos Fitopatógenos, Instituto Agroforestal Mediterráneo, Universidad Politécnica de Valencia, Camino de Vera s/n, 46022 Valencia, Spain.

7Süleyman Demirel University, Faculty of Forestry, 32260 Isparta, Turkey.

8EXCMA, Diputación Provincial de Pontevedra, Servicio Agrario, Estación Fitopatología "do Areiro", Subida a la Robleada S/N, 36153 Pontevedra, Spain.

9Plant Protection Institute, Hungarian Academy of Sciences, Herman Ottó út 15, 1022 Budapest, Hungary.

10Department of Agri-Food and Environmental Systems Management, Plant Pathology Section, University of Catania, 95123 Catania, Italy.

11Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW), Seckendorff-Gudent-Weg 8, A-1131 Vienna, Austria.

12NAGREF-Forest Research Institute, 570 06 Vassilika-Thessaloniki, Greece.

13Department of Agricultural Biotechnology, Section of Plant Protection, University of Florence, Piazzale delle Cascine 28, I-50144 Florence, Italy.

14Finnish Forest Research Institute, Vantaa Research Centre, P.O. Box 18, 01301 Vantaa, Finland.

15Lower Saxony Forest Research Station, Grätzelstrasse 2, D-37079 Göttingen, Germany.

16Norwegian Institute for Agricultural and Environmental Research (Bioforsk), Plant Health and Plant Protection Division, Høgskoleveien 7, 1432 Ås, Norway.

17Faculty of Forestry, University of Belgrade, Kneza Visaslava 1, 11030 Belgrade, Serbia.

18National Forestry University of Ukraine, Forestry Department, General Chuprynyk Str. 103, 79057 Lviv, Ukraine.

19Agrobiointitute, Centre of Excellence in Plant Biotechnology, 8 Dragan Tsankov Blvd., 1164 Sofia, Bulgaria.

20Instituto Nacional de Recursos Biológicos, Unidade de Silvicultura e Produtos Florestais, Quinta do Marquês, 2780-159 Oeiras, Portugal.

21INRA, Nancy Université, UMR 1136 Interactions Arbres / Microorganismes, IFR 110, F-54280 Champenoux, France.

22Bavarian State Institute of Agriculture (LfL), D-85354 Freising, Germany.

23Department of Forest Phytopathology, Forest Research Institute, ul. Braci Lesnej 3, 05-090 Raszyn, Poland.

24Laboratory of Plant Pathology, Agricultural University of Athens, 75 Iera Odos, 11855 Athens, Greece.

25INRA, UMR BioGeCo, 69 route d'Arcachon, 33612 Cestas Cedex, France.

26Departamento Agronomía, ETSIAM, Universidad de Córdoba. Apdo. 3048, 14080-Córdoba, Spain.

27University of Sassari, Department of Plant Protection, Via Enrico De Nicola, 9, 07100 – Sassari, Italy.

28Scottish Government-SASA, Plant Health, Roddinglaw Rd, Edinburgh, EH12 9FJ, UK.

29Forest Research Institute Baden-Wuerttemberg, Department of Forest Protection, Wonnhaldestrasse 4, D-79100 Freiburg, Germany.

30NAGREF-Institute of Mediterranean Forest Ecosystems, Terma Alkmanos, 11528 Athens, Greece.

31Department for Innovation in Biological, Agro-Food and Forest Systems, University of Tuscia, Via S. Camillo de Lellis, 01100 Viterbo, Italy.

32Wageningen UR/Applied Plant Research, Sector Flower bulbs, Tree nursery & Fruit, Lingewal 1, 6668 LA Randwijk, 6670 AE Zetten, the Netherlands.

Corresponding author: trjung@ualg.pt

Abstract

Large-scale *Phytophthora* surveys in (1) forest nurseries, advanced tree nurseries, horticultural nurseries and ornamental nurseries and (2) forest, riparian, amenity, landscape and ornamental plantings and horticultural plantations were conducted by 32 research groups in 21 European countries between 1977 and 2012 with most surveys dating from after 2000.

Over all countries and nursery types, 1283 out of 1620 nursery fields and container stands (79.2%) in 563 out of 601 nurseries (93.7%) were found infested by a total of 40 different species and designated taxa of *Phytophthora*.

In most nurseries highly deleterious host-*Phytophthora* combinations were found, eg. *Alnus* spp. and *P. alni*; *Quercus* spp. and *P. cambivora*, *P. cinnamomi*, *P. quercina* and/or *P. plurivora*; *Castanea sativa* and *P. cambivora* and/or *P. cinnamomi*; *Fagus sylvatica* and *P. cactorum*, *P. cambivora* and/or *P. plurivora*; *Citrus* spp. and *P. citrophthora* and/or *P. nicotianae*; *Rhododendron* and *P. cinnamomi*, *P. plurivora* and/or *P. ramorum*.

In contrast to many southern European nurseries where wilting and dieback symptoms were quite common, most of the infested plants in intensely managed nurseries in Central and Western Europe with regular applications of several fungicides and fungistatic chemicals appeared visually healthy underpinning the uselessness of international plant health protocols that are primarily based on visual inspections.

In the planting surveys a total of 48 *Phytophthora* taxa were recovered from 1498 of the 2353 tested plantings (63.6%) As with the nursery fields, plants were often infected by the most aggressive pathogens towards the respective host species. Infected plants often showed symptoms such as thinning, chlorosis and dieback of the crown, extensive fine root losses and collar rot.

The average numbers of *Phytophthora* species/taxa per infested nursery and planting were 1.8 and 1.4, respectively.

Thirty-two of the *Phytophthora* species/taxa detected are considered exotic invasive species. Amongst them *P. cactorum*, *P. cambivora*, *P. cinnamomi*, *P. cryptogea*, *P. plurivora* and *P. quercina* are widespread in Europe and must be considered as well established in both nurseries/plantations and mature stands.

Several *Phytophthora* species/taxa have been found for the first time in Europe, ie. *P. austrocedrae*, *P. gregata*, *P. humicola*, *P. quercetorum*, *P. rosacearum*, *P. taxon citricola* 5 and 6, *P. taxon organica* and *P. taxon gregata*-like; while others have never or only rarely or regionally been recorded from mature stands, ie. *P. kernoviae*, *P. lateralis*, *P. multivora*, *P. pini* and *P. ramorum*. These apparently recent introductions demonstrate that alongside the exponentially increasing volume of imports of living plants from overseas to Europe the unintended introductions of *Phytophthora* species are also increasing dramatically.

According to a conservative calculation 770000 infested forest plantings with a total area of 5.4 million hectares have been established in Europe between 1990 and 2010. Millions of infested landscape plantings and ornamental plantings in the urban-forest interface and tens of thousands of kilometers of roadside and riparian plantings of infested advanced trees and shrubs are completing the dense network of *Phytophthora* infestations across Europe.

The findings of this and previous studies demonstrate major failure of plant biosecurity in Europe which will be discussed.

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