engineering proceedings

Abstract

Application of a Low-Cost Electronic Nose for the Detection of Forest Tree Pathogens †

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† Presented at the 9th International Symposium on Sensor Science, Warsaw, Poland, 20–22 June 2022.

Abstract: Several techniques can be used for the detection and analysis of odors. Among them, electronic noses emerged as a rapid and non-invasive diagnostic tool with various applications ranging from the food industry to medical diagnosis or forestry and agriculture. The concept of an electronic nose consists of using an array of nonspecific gas sensors equipped with machine learning pattern recognition algorithms. A few devices based on MOX (metal-oxide) commercially available sensors (Figaro Inc., Osaka, Japan) have been constructed in our laboratory. The operation of developed devices consisted of measuring sensors' conductivity, carried out as a response to changing operation conditions by moving sensors from clean air to the vicinity of the sample where volatile organic components are present. Additionally, the sensors' operation in various working temperatures was exploited. Our goal was to develop an inexpensive and effective tool for the early detection of tree diseases caused by pathogenic oomycetes such as fungi. The devices were tested, both on pure cultures of cultivated organisms, and in interaction with infected plants. Distinguishing between the pathogenic oomycetes *Phytophthora plurivora* and *Pythium intermedium*, and *the fungi Fusarium oxysporum* and *Rhizoctonia solani*, by detecting the odors of their volatile secondary metabolites has been reported. Information about which pathogen we are dealing with in forest nurseries allows us to design an appropriate plant protection strategy (e.g., selecting appropriate pesticides). Experiments aiming to detect the fungal infection of tree seeds during storage were also performed on English oak (*Quercus robur*) acorns and silver fir (*Abies alba*) seeds. Additionally, studies of ash (*Fraxinus excelsior*) dieback caused by *Hymenoscyphus fraxineus* pathogenic fungi using a PEN3 electronic nose device (portable electronic nose, Airsense Analytics GmbH, Schwerin, Germany) were performed by measuring infected roots and soil.

Keywords: electronic nose; pathogens; VOCs; coma; fungi; oomycetes

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Citation: Oszako, T.; Borowik, P.; Tarakowski, R.; Ślusarski, S.; Tkaczyk, M.; Wacławik, P.; Nowakowska, J.A. Application of a Low-Cost Electronic Nose for the Detection of Forest Tree Pathogens. *Eng. Proc.* **2022**, *21*, 19. https://doi.org/10.3390/engproc2022021019

Academic Editors: Piotr Lesiak, Tomasz Woliński and Leszek Jaroszewicz

Published: 24 August 2022

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Author Contributions: Conceptualization, P.B. and T.O.; methodology, M.T.; software, P.B.; validation, P.B., S.Ś. and J.A.N.; formal analysis, M.T.; investigation, M.T.; resources, R.T. and T.O.; data curation, P.B. and R.T.; writing—original draft preparation, J.A.N.; writing—review and editing, T.O.; visualization, P.W.; supervision, S.Ś.; project administration, S.Ś.; funding acquisition, P.W. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the National Centre for Research and Development by the grant agreement BIOSTRATEG3/347105/9/NCBR/2017.

Conflicts of Interest: The authors declare no conflict of interest.