PRELIMINARY ANALYSIS OF QUERCUS SUBER FOREST SOILS IN TUNISIA: SOIL ENDOGENOUS FUNGAL NICHE AND PHYSICAL-CHEMICAL STATUS

C Rodrigues1,2, I McLellan4, MC Leitão1, A Varela1,3, MB Carvalho1, I Martins1, H Garcia1, M Petkovic1, A Hursthouse4, MV San Romão1,2,6 and C Silva Pereira 1,2*, corresponding author

1) Instituto de Tecnologia Química e Biológica (ITQB), Apartado 127, 2780-901 Oeiras, Portugal
2) Instituto de Biologia Experimental e Tecnológica (IBET), Apartado 12, 2780-901 Oeiras, Portugal
3) INRB/L-INIA (Ex-EAN), Av. da República, Quinta do Marquês, 2784-505 Oeiras, Portugal
4) School of Engineering & Science, University of the West of Scotland, Paisley, PA1 2BE, UK
5) INRB/L-INIA (Ex-EVN), Quinta de Almoínha, 2565-191, Dois Portos, Portugal

SUMMARY

Environmental contamination by persistent organic pollutants (POPs), such as pesticides, constitutes a global concern and a special threat due to their persistence in the environment, long range transport and bioaccumulation in humans and wildlife. Agro-forestry ecosystems receive man-made chemicals that lead to soil, water and air contamination. Agricultural pollution has often been considered, but wood forests, commonly accepted as non-polluted environments, yet receiving high quantities of pesticides and wood preservatives, have been almost neglected. Soil is the largest and most active environmental compartment and is critical for the natural attenuation of POPs, mostly due to their strong absorption to the humic matter and microbial transformation by soil endogenous microbiota, which is a major fate component. Among the soil microbial community, fungi are especially important, as they secrete a variety of extracellular enzymes, which ensure the decomposition of the highly recalcitrant plant composites and the breakdown of xenobiotic compounds. Amongst other significant POPs, the toxicological significance and environmental behavior of pentachlorophenol (PCP) validate its selection as a reference chemical for aquatic environment quality assessment. Moreover, in 2001, the Water Frame Directive recommended urgent research on PCP fate and impacts. PCP use is nowadays world-wide restricted, yet, surprisingly, PCP and some metabolic by-products are still found in the Arctic sediment core, suggesting that continuous applications are still adding to Arctic contamination. In fact, PCP can be released during the incineration of urban wastes and chlorination treatments of water, reinforcing the concerns of long-term consequences of exposure to humans and wildlife. Additionally, PCP degradation products, e.g. 2,3,6-TCP is likely to be carcinogen to humans.

Quercus suber forest (oak forest) was selected for PCP monitoring, because of inherent high risk and global and regional importance. PCP and its metabolic by-products are very likely to be found dispersed in the oak forests, because PCP fungal metabolites are occasionally found to contaminate cork slabs. Moreover, the number of POPs monitoring sites is especially unsatisfactory in the south and east of Europe and a “multi-purpose” monitoring strategy, linking urban, rural and global sites is lacking. The transformation of PCP within specific environments was already studied, emphasizing that most ecosystems are contaminated; yet, this study is the first to analyze PCP fate in oak forests.

Soil samples (0-20 cm deep) were systematic sampled inside Tunisian forests in summer 2007, and immediately sieved, packed and sent for analysis. Two samples collected at two distinct locations of pure oak forest were initially selected for a preliminary evaluation. The most distinctive feature of the two locations is the presence (F1) or not (F2) of a dense shrub vegetation. This difference is well expressed in the soil humidity that is higher for F2 (c. 23%) than F1 (10%). Other soil physical-chemical parameters (pH, C/N ratio, etc) suggest moderate sample instability (probably due to transport and conservation). Initially results suggest PCP global contamination, yet, F1 is apparently less contaminated than F2 (0.3±0.08 and 0.6±0.25 mg PCP per kg of dry soil, respectively). Fungal isolates in the soil samples were cultivated after their extraction with peptone water (1 hour) and immediately spread onto solid culture media (MEA and
Their main morphological characteristics were annotated and the key features of their colonies were used for grouping the isolates accordingly to their morphological similarity. PCP is known to reduce the species diversity in the natural niche. There is c. 18 % less distinctive isolates in F2 sample. The number of isolates sharing a common morphological aspect found at the two locations constitutes c. 18 % of the total isolated community. Taxa distribution of the isolates varies significantly in the two soils and the most frequent taxa identified until now are Penicillium and Aspergillus. On-going work includes the identification of the fungal species and the systematic evaluations of new soil samples collected at different seasons. In future, integration of data obtained by different laboratories will allow the evaluation of the significance of this study and the correlation between PCP pollution status with soil characteristics and microbiota.

Acknowledgements: The authors are deeply thankful to NATO sfp-981674 team members, especially to Prof. A. Hassen, Prof N. Ben Aissa and Eng. H. Kallali who have controlled the soil sampling inside Tunisian forest. The work was partially supported by the projects: POCTI/AMB/57374/2004/ FCT and POCTI/QUI/56229/2004/ FCT and NATO sfp sfp-981674/ NATO.