Study of the nematode diversity in the Chernobyl Exclusion Zone

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Abstract:

The aim of the study was to assess the effects of former radioactive contamination on the structure of the nematode community in sites affected by the fallout from the Chernobyl accident. Nematodes were collected in spring 2011 from 18 forest sites of the Chernobyl Exclusion Zone (CEZ). The external gamma dose rates, measured from radiophotoluminescent dosimeters varied from 0.2 to 22 µGy h^{-1} between sites. In parallel, the Total dose rates (TDR) absorbed by nematodes were predicted from measured soil activity concentrations, Dose Conversion Coefficients (DCC, calculated by the EDEN software) and Soil-to-biota concentration ratios (from the ERICA tool database). Results showed that TDR were one order of magnitude above the external gamma dose rate measured from RPL. This is mainly due to the contribution of alpha (^{241}Am, ^{238,239,240}Pu) and beta (^{90}Sr, and ^{137}Cs) emitters in the external dose rate. The small size of nematodes promoted a high energy deposition throughout the organisms without fading, giving more weight to external dose rate induced by α and β-emitters, relatively to γ-emitters.

The nematode community corresponded to a majority of bacterial-, plant-, and fungal- feeding nematodes and almost none of the disturbance sensitive families whatever the site. Multiple regression analysis was used to establish relationships between ecological features (abundance and family diversity, indices of ecosystem structure and function) to the TDR and soil physico-chemical properties. No evidence was found that nematode total abundance and

family diversity were impaired by the radiological contamination. However, the Nematode Channel Ratio (defining the relative abundance of bacterial- versus fungal-feeding nematodes) decreased significantly with increasing TDR suggesting that the radioactive contamination may influence the nematode assemblage either directly or indirectly by modifying their food resources. Greater Maturity Index (MI), usually characterising better soil quality, was associated to greater pH, moisture and TDR values. These results suggest that of the nematode community from CEZ is slightly impacted by chronic exposure to ionising radiation for predicted TDR reaching more than 200 µGy h^{-1}. This dose rate is 20 times higher than the predicted no-effect dose rate (to be used in ecological risk assessment). This result confirms previous study which revealed a low radio-sensitivity of terrestrial invertebrates to chronic radiation exposure. This apparent low sensitivity of nematode community to chronic exposure to radioactive soils may be partly explained by the dominance in the sampling soils of nematodes that are naturally resistant to pollutant and environmental disturbance.