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Kinetics of plant leaves decomposition, DNA release and transport in unsaturated soil medium

(1) John Poté

(2) Walter Rosselli

(3) Andrea Wigger

(1) Walter Wildi

(1) Forel Institute, University of Geneva, 10, route de Suisse 1290 Versoix CP 416, Switzerland

(2) WSL Swiss Federal Research Institute, P.O. Box 96, 1015 Lausanne, Switzerland

(3) Horticulture School of Lullier, 150, route de Presinge 1254 Jussy. Switzerland

The studies regarding the decomposition and transport of DNA in soil are generally based on the use of extracted and purified DNA. However, in this study natural processes of plant decomposition in soil, DNA release, and vertical movement of the released DNA in vadose zone were simulated in order to evaluate the possible transport of plant DNA and the risk of DNA reaching groundwater.

Microcosms were used to examine the kinetics of leaf and DNA content decomposition in two varieties of tomato leaves after incubation in soil for 35 days. The quality and the quantity of DNA in tomato leaves were examined. DNA quality has been measured by the distribution of DNA size on agarose gel and DNA quantity was measured spectrophotometrically (D_{260}). The results revealed that the decrease of dry matter was better described by double exponential model. Genomic analysis showed that DNA extracted from non-sterile soil showed degradation after two days and DNA in dried leaves not inoculated in the soil remains intact or present a weak degradation. These results indicate that before release an important quality of DNA may be degraded inside plant tissues during decomposition in soil.

Unsaturated soil columns were performed to examine the transport of DNA in vadose zone. Soil columns contained tomato leaves were leached with sterile water at

a rate of 0.5 mL $h^{-1}$for 104 days. DNA from column leachate water was extracted and analysed. Both quantitative and qualitative measurements of extracted DNA were taken. Tomato gene sequences were detected using PCR amplification based on tomato specific 18S primers. The concentration of total DNA in soil column leachate water ranged from 6.7 to 50.4 μg L^{-1}. Genomic analysis using showed degradation of DNA after its passage through unsaturated soil columns. The presence of tomato genes in the leachate water of soil columns suggests a potential release of tomato DNA from leaves and potential transport of DNA over considerable distances in water-unsaturated soil. Consequently, transport of plant DNA in vadose zone is indicated, and there is a risk that the DNA may reach the groundwater.

The further application and extension of this work could consider the persistence of DNA in transgenic plants leaves and the effects of microbial components during dry matter decomposition in different soils. In order to predict the transport of DNA through unsaturated soil conditions, the following need to be taken into account: the characteristics of the initial source of DNA, the release processes, the soil characteristics, the persistence of DNA, the possible transfer to indigenous soil microorganisms, and whether DNA is transported in the dissolved or adsorbed state.

References:

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