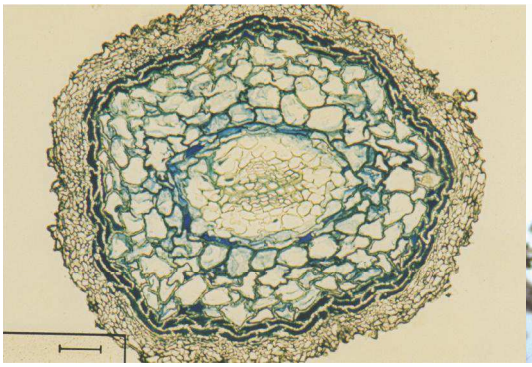

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Investigation of spatial and temporal oxygen evolution during root-pathogen interaction using planar optodes

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Oxygen (O_2) dynamics and exchanges between plant roots and fungal pathogens have been traditionally investigated using physiological and gene expression analysis of root fragments. Apart being time and cost consuming, these methods are invasive and therefore not suitable to properly elucidate the belowground interactions. To overcome these limitations, we performed an in-vitro experiment with an optical, non-invasive device (planar optode, Visisens, Germany) to assess the spatio-temporal dynamics of O_2 in the colonization of tomato roots by the pathogen *Fusarium oxysporum*. Planar optodes is a non-invasive technology based on the use of an optical sensor foil (i.e. planar optode) in contact with the surface of the sample, which translates the O_2 signal into a light signal, afterwards captured and interpreted pixel by pixel by a digital camera. The analysis of the 5 min time step image series, indicated that the root oxygen consumption followed the night-day cycle (i.e. the normal photosynthesis determined path) before the pathogen colonization, whereas the fungus metabolic activity followed a different and independent path. After the interaction there was an increase of the respiratory activity which reached a peak after about 67 hours. The symptoms on the aerial part of the plant were visible about ten days after the beginning of the experiment as discoloured areas on the outer borders of the leaves that soon became brown and necrotic. The knowledge of the exact surface area, the O_2 concentration, the time step, the air temperature and the atmospheric pressure allowed the calculation of the respiration rates of both the root and the fungus. Basically we could follow the root and pathogen metabolic activity in real time and without any interference, therefore asserting the effectiveness of planar optodes even in the study of such complex biological interactions.