Research Project of National Interest (PRIN-PNRR) DIVAS: Developing Methods to Assess Tree Vitality after a Wildfire through Analyses of Cambium Sugar Metabolism

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Abstract : The development of tools to quickly identify the fate of injured trees after stress is highly relevant when biodiversity restoration of damaged sites is based on nature-based solutions. In this context, an approach to assess irreversible physiological damages within trees could help to support planning management decisions of perturbed sites to restore biodiversity, for the safety of the environment and understanding functionality adjustments of the ecosystems. Tree vitality can be estimated by a series of physiological proxies like cambium activity, starch, and soluble sugars amount in C-sinks whilst the accumulation of ethanol within the cambial cells and phloem is considered an alert of cell death. However, their determination requires time-consuming laboratory protocols, which makes the approach unfeasible as a practical option in the field. The project aims to develop biosensors to assess the concentration of soluble sugars and ethanol in stem tissues. Soluble sugars and ethanol concentrations will be used to define injured trees to discriminate compromised and recovering trees in the forest directly. To reach this goal, we select study sites subjected to prescribed fires or recent wildfires as experimental set-ups. Indeed, in Mediterranean countries, forest fire is a recurrent event that must be considered as a central component of regional and global strategies in forest management and biodiversity restoration programs. A biosensor will be developed through a multistep process related to target analytes characterization, bioreceptor selection, and, finally, calibration/testing of the sensor. To validate biosensor signals, soluble sugars and ethanol will be quantified by HPLC and GC using synthetic media (in lab) and phloem sap (in field) whilst cambium vitality will be assessed by anatomical observations. On burnt trees, the stem growth will be monitored by dendrometers and/or estimated by tree ring analyses, whilst the tree response to past fire events will be assessed by isotopic discrimination. Moreover, the fire characterization and the visual assessment procedure will be used to assign burnt trees to a vitality class. At the end of the project, a well-defined procedure combining biosensor signal and visual assessment will be produced and applied to a study case. The project outcomes and the results obtained will be properly packaged to reach, engage and address the needs of the final users and widely shared with relevant stakeholders involved in the optimal use of biosensors and in the management of post-fire areas. This project was funded by National Recovery and Resilience Plan (NRRP), Mission 4, Component C2, Investment 1.1 - Call for tender No. 1409 of 14 September 2022 – 'Progetti di Ricerca di Rilevante interesse Nazionale – PRIN' of Italian Ministry of University and Research funded by the European Union – NextGenerationEU; Grant N° P2022Z5742, CUP B53D23023780001.

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