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Root exudates involvement in tomato plants response to low P levels

Veronica Santoro (1), Maria Martin (1), Daniel Said-Pullicino (1), Michela Schiavon (2), Andrea Ertani (2), Serenella Nardi (2), Francesca Cardinale (1), Ivan Visentin (1), and Luisella Celi (1)

(1) Università degli Studi di Torino, DISAFA (Dipartimento di Scienze Agrarie, Forestali e Agroalimentari), Grugliasco (TO), Italy, (2) Università di Padova, DAFNAE (Dipartimento di Agronomia, Animali, Alimenti, Risorse naturali e Ambiente), Legnaro (PD), Italy

Phosphorus (P) is an essential macronutrient required by plants as it plays a vital role in major metabolic processes and is a structural component of cellular molecules. In most soils, its concentration can be very low, as its use efficiency is determined by abiotic processes (adsorption on mineral surfaces and precipitation as insoluble salts) that immobilize P reducing its mobility and limiting the fertilizers diffusion to a short distance from the point of application. Plants have evolved several strategies to exploit localized sources of P to cope with low P conditions and to optimize growth and productivity. Among these, a higher production of exudates that compete with P for the same adsorption sites, a higher production of electron-rich species which can reduce iron oxides and cause the release of phosphate and a higher production of phosphatases and phytases which can hydrolyse organic P-compounds. Also strigolactones (SL) have been suggested to be involved in plants response to P availability. They are signalling molecules involved in a number of physiological processes in plants (regulation of plant architecture, response to nutrient availability, establishment of symbiosis with AM-fungi) and have recently been recognised as phytohormones. Several studies demonstrated a role for SLs in roots and shoots response to low P conditions. In the context of the European project named TOMRES, aiming at enhancing tomato plants resilience to combined water and nutrient stress, we are studying the root exudates involvement in plants response to low P conditions. We grew up wild-type (WT) tomato plants and plants with gene for SL synthesis silenced (SL-). After a period of growth in normal nutrient conditions, plants were kept in P stress regimen (15 days). Root exudates were then collected and analysed for inorganic P, total C, N and P, organic acids, polyphenols and SL contents and tested for hormone-like activity. Plants biomass parameters were measured and then roots and shoots were analysed for total C, N and P content as well. Our results highlighted differences in WT and SL- plants biomass, in P distribution between roots and shoots and in exudates composition. In particular, the main diversities were spotted in the organic acids and polyphenols amount and composition. In addition, some of the exudates were found to have gibberellic-like or indolacetic-like hormonal activity. As in soils P is often adsorbed onto iron (Fe) (hydr)oxides surfaces or precipitated in the form of Fe salts, we are now testing the ability of some of the organic acids and polyphenols identified in the exudates to dissolve P-Fe systems either by complexation or reductive dissolution, enabling P uptake by plants.