STSM Recipient	Almudena Ferrández-Ayela Universidad Miguel Hernández de Elche (Spain)
Host Laboratory	Dr. Ian Dodd, Lancaster Environment Centre, Lancaster University (UK)
Proposed project	Do vigorous root systems mediate rootstock effects on resource capture?
Introduction	Roots are specialized plant organs that fulfill basic functions of water and nutrient uptake and of mechanical support. Furthermore, plant roots interact with the soil environment by sensing and responding to biotic and abiotic stimuli. Root system architecture (RSA) varies extensively between and within genotypes and contributes to improve plant performance under stress. RSA adaptations are important to enhance water and nutrient acquisition from the soil. In tomato, the *root regeneration1* (*rgr1*) allele confers elevated shoot and root formation capacity, while the *bushy root* (*brt*) mutation causes highly branched root systems, hence allowing the possibility to functionally dissect the crosstalk between shoot and root tissues in regulating resource capture and yield.
Materials and Methods	The tomato *rg1* and *brt* mutants will be reciprocally grafted with their respective wild-types and between them (9 grafting combinations in total), and grown in soil columns (able to fit in a Scholander pressure chamber to expedite root xylem sap sampling) where soil moisture is heterogeneously distributed by basal watering. Rootstock effects on shoot physiology will be periodically quantified, and root function (water uptake) and distribution determined by various approaches including wax discs buried in the substrate. The phenotyping of the root system will determine whether RSA in these genotypes is a shoot-or root-mediated trait. Samples from leaves, roots and xylem sap will be collected, rapidly frozen in liquid nitrogen, then analyzed for nutrient ions and phytohormones (abscisic acid, ABA and the ethylene precursor ACC) using immunological or physico-chemical (ICP-OES, GC) measurements. Candidate genes related to hormone biosynthesis and RSA architecture will be analysed by qRT-PCR, using as a template the RNA extracted from roots and leaves.
Tasks	- Establish self- and reciprocal grafts of tomato genotypes - Assay the physiological effects of rootstock by measuring leaf growth rate and plant water use at different levels of soil moisture status, and determine root function and distribution - Establish correlations between root architecture, root signal output and physiological measurements - Determine whether different measurements of root hydraulic conductance (osmotic- and pressure-induced flow) are correlated in diverse rootstocks - Determine whether there are changes in the gene expression profiles of hormone-related genes both in the shoot and root systems of the different grafting combinations
Deliverables	- Publish a methodology that partitions the effects of root system vigour on resource (water) capture and root-to-shoot signaling in grafted plants (where rootstock and scion genetically differ) and disseminate information at COST meetings and other appropriate conferences.

D**uration**	6 weeks (14 October 2013 to 24 November 2013)
Benefits to COST Action (FA1204)	This research relates directly to WG1 as this work will help to evaluate the potential of new rootstocks and graftable species. It is also directly related to WG2 by measuring chemical compounds (eg. hormones, nutrients and RNAs) and hydraulic signaling between root and shoots, thereby collecting information on the biochemistry and physiology of root-shoot communication, and supplying valuable genetic information extracted from the qRT-PCR assays. Furthermore, by imposing a soil drying treatment, this work is related to WG3 by providing information on rootstock effects on water or nutrient use efficiency and the mechanisms underlying physiological responses to these abiotic stresses.
Likely future joint applications	Both laboratories are participating within the EU ROOTOPOWER project, and are seeking further opportunities to collaborate on the regulation of adventitious rooting by genetic and phytohormonal factors