Master thesis project: Root fusion in plants – establishing a model system using strangler figs

Background and aim: Plants have the remarkable ability to fuse with other plant individuals, particularly if they are closely related. Humans have made use of this ability to vegetatively propagate plants, for example when grafting an apple tree onto a root stock. In nature, natural grafts can form when roots press against each other and create a functional fusion. Such root fusions can for example transfer carbohydrates to support shaded trees. Root fusion is common in forests between trees of the same species, especially in forestry plantations where many individuals are closely related. This is a major problem within forestry because pathogens, such as root rot fungus, can spread using root grafts, so forestry seeks to suppress root grafting.

We would like to study the root fusion (also called root grafting) process further - for this it would be useful to have a lab based model system. Plants of the genus *Ficus* is promising as a root fusion model system because a subset of *Ficus* species, the strangler fig trees, create abundant root grafts as they grow. Strangler fig trees start life in the canopy as epiphytes, and send roots down to the forest floor. The roots thicken and fuse with each other, producing a strong fused mesh surrounding the host tree; see for example here for some typical photos: https://maginams.ca/strangler-figs/ Strangler fig trees fuse their roots (presumably) to create sturdy support and to strangle their host tree to death so that they can take over that spot of sunlight in the canopy. We plan to use the exceptional root fusing ability of strangler figs to establish a root fusion model system in the lab, and study the fusion process in detail. Our pilot studies suggest it would work well in the lab.

Project tasks: The master project would be mostly lab based, and involve growing plants, setting up experiments, histology, and imaging. You would establish a model system for studying root fusion in the laboratory, and describe in detail how fusion occurs within a plant individual for one or two species. Imaging would be done initially by confocal microscopy or light microscopy, then you would prepare thin embedded sections using a microtome for detailed morphology analyses such as cell division patterns and vascular differentiation. Fluorescent dyes can be applied and movement of the dye followed. If time allows you could also set up experiments to test other questions, such as to what degree fusion between different individuals and species is affected by how closely related they are, or whether you could produce root fusion in the lab in other species such as Norway spruce or Scots pine. Apart from the lab skills you will also get experience with scientific writing and presentation.

Location: Lab work will be in Charles Melnyk's lab at SLU Uppsala. Supervision will be by Charles Melnyk (SLU Uppsala; https://melnyklab.com/) and Charlotte Jandér (UU; https://sites.google.com/view/charlottejander/home).

Project length: 30 / 45 / 60 hp.

Start date: According to agreement.

Contact: If interested, please contact charlotte.jander@ebc.uu.se