Unravelling the role of Gibberellins (GAs) at the interface of vascular reprogramming during clubroot disease in Arabidopsis.

Oilseed rape and its friends in the mustard family serve as the exclusive targets for a menacing pathogen called *Plasmodiophora brassicae*. Being a soil-borne obligate biotroph, it enters its host plant *via* roots and gradually builds a metabolically active niche for itself in the form of galls, shaped like 'clubs', on underground parts of the plant. What happens inside the gall is not just biologically phenomenal but developmentally intriguing. The pathogen exploits the galls as sites carefully tailored to divert nutrients and serve as its nurturing abode. Galls harbour an intricate network of host's water distribution system (xylem) and nutrient-transport system (phloem). However, due to major cellular reprogramming occurring inside galls, these transport systems (vascular tissues) become functionally compromised by the pathogen and their development gets altered drastically. Development of phloem is enhanced to enrich the galls with nutrients for the thriving pathogen, although this occurs at the cost of xylem suppression. Since xylem and phloem are daughters of the same mother, *i.e*., they are born from the same bifacial stem-cells of the vascular cambium, their development and fates are intertwined. Clubroot galls function analogously to tumorous tissues which are formed by increased cell proliferation. However, they also undergo cell enlargement during later stages (hypertrophy) to accommodate resting spores for pathogen propagation. Once the plant succumbs to disease it wilts and the galls degenerate to release resting spores in the soil which remain viable for next twenty years! This calls for urgent research initiatives to stop this pathogen or atleast provide plants with a solution to tolerate or resist this disease. We in our team try to address 'the root of the club', to understand how this proficient pathogen is able to change the basic blueprints of plant development and rewrite them to evoke massive changes in the xylem and phloem formation within its host. For this we employ our little green friend, *Arabidopsis thaliana*, the most accessible model system to work in the plant research community. Since, it's a member of the very same family, it acts as the perfect host for *P. brassicae*.

In the proposed project, our focus is to understand how plant hormone gibberellin (GA), a deciding factor acting at the interface of vascular cambium is linked to the abnormal xylem and phloem development in clubroot galls. Backed by strong preliminary data from our group, we have evidences indicating lower levels of components involved in gibberellins (GAs) synthesis within galls. Owing to these findings, we would be undertaking different approaches to carefully decipher the genetic and physiological components which might underlie the changes in GA levels, perception and responses in infected plants. For this reason, we would be analysing how GAs accumulate locally within developing galls using FRET sensor nlsGPS2 (Gibberellin Perception Sensor) with confocal microscopy to create a map for GA dynamics with cellular resolution. We will also measure GAs within infected and healthy plants to understand how GA economy changes globally to affect GA homeostasis. Since GAs are mobile and they control developmental decisions over long distances, it would be interesting to compare GA profiles between healthy *versus* infected plants. Furthermore, we would be assessing a variety of Arabidopsis plants with modifications in GA production and perception which would help us in narrowing down the exact GA-associated components which might be tweaked and exploited by *P. brassicae* to affect xylem/phloem development within developing galls. This work gain support from our international collaborators Dr. Alexander Jones Sainsbury Laboratory, Cambridge, Prof. Peter Hedden and Dr. Danuse Tarkowska at Olomouc, Czech Republic. Since the role of gibberellins has been overlooked by the clubroot community, our project would provide novel insights which would help in gaining a profound understanding of how this underappreciated hormone could actually be the key factor responsible for the characteristic vascular tissue reprogramming occurring within galls. Our findings would provide a new perspective on gall development and offer promising avenues to target gibberellins as a target for improving tolerance against clubroot.