Title

Functional analysis of drought tolerance promoting endophytes in the growth zone of maize leaves

Description

There is a growing demand for sustainable food and energy crops that maintain high productivity in the context of changing climate conditions, while minimizing inputs from chemical fertilizers, herbicides and insecticides. Major gains have been made by genetic selection for high-yielding varieties and adapting genotypes to specific environmental conditions. However, much of this improvement has been made in the context of modern agricultural practices that involve the application of chemicals. The use of leguminous crop species and *Rhizobia* bacteria to fix Nitrogen was a first use symbiotic relationships between plants and microbes to reduce crop dependency on nitrogen fertilizer[7]. Since the discovery of *Rhizobium* in the early 19th century, scientists have identified numerous other bacterial and fungal species with growth-promoting effects on plants either through rhizospheric or endophytic relationships. The term endophyte refers to fungal and bacterial microorganisms living within plant tissue without causing disease. Presumably symbiotic relationships result from selection for associations between plant and symbionts that provide maximum mutual benefits. The benefits to the plant might include growth stimulation through the production of growth hormones, nitrogen fixation, enhanced nutrient uptake and protection from pathogens. Endophytic relationships also bestow both abiotic and biotic stress tolerance to plant hosts. These interactions suggest that endophytes have co-evolved toward symbiosis with plant hosts.

In addition to the growth promoting interactions between the soil microbiome and plants there is growing evidence that areal plant tissues have their own microbiome of endophytes. Several of these stimulate growth under optimal or limiting conditions, providing a potential for a sustainable enhancement of crop productivity, but how they affect the growing tissues is largely unclear. To this end, project uses the growing *Zea mays* (maize) leaf as a model system. Cells of maize leaf are organized in files running along the length of the leaf with cell division in the leaf meristem at the base of the leaf and cell expansion in the adjacent elongation zone. This linear organization allows us to quantify cell division and expansion rates by means of kinematic analysis to determine the contribution of these processes to the overall Leaf Elongation Rate (LER).

Recently, we isolated two novel endophytic bacteria which effectively reducd the effects of drought on maize growth. The reduced effect of drought on plants inoculated with our novel endophytic strains was mainly due to a positive effect of the endophytes on cell production due to an increased meristem size and a higher average cell division rate under drought conditions

With regards to the interaction between these novel growth-promoting endophytic bacteria and maize plants, the reprogramming of the growth zone provides an important “proof of concept” and preliminary data, but also raises a number of pertinent questions:

- ***Do these endophytes all live in the growing cells or is their effect indirect?***
- ***What is the impact of the metabolic changes in the growth zone on their development and physiology?***

- ***By which mechanisms do they alter the growth processes, particularly under drought conditions?***

Techniques

Endophytic bacteria and fungi isolated from the leaf growth zone of grasses growing in arid conditions will be functionally characterised using a multidisciplinary approach. This will involve →culturing and in planta testing of isolates for their effect on leaf growth under optimal and drought conditions.

→The genome of growth promoting isolates will sequenced, annotated and phylogenetically analysed.

→ Functional analysis of the endophytes in planta will include kinematic analysis of cell division and expansion in the leaf growth zone, flowcytometry

→ Metabolome analysis and quantification of endophyte numbers under control and drought conditions.

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- There is a PowerPoint presentation for this topic