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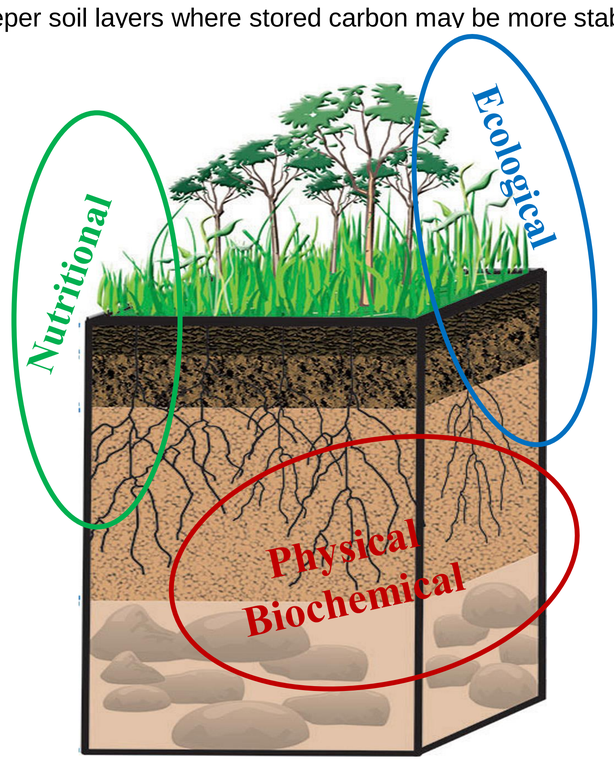
The effect of Intercropping on the Deep Root Development and Nutrient Uptake in a Sugar Beet – Chicory Mixture

DeepFrontier - Exploring Potentials of Deep Roots

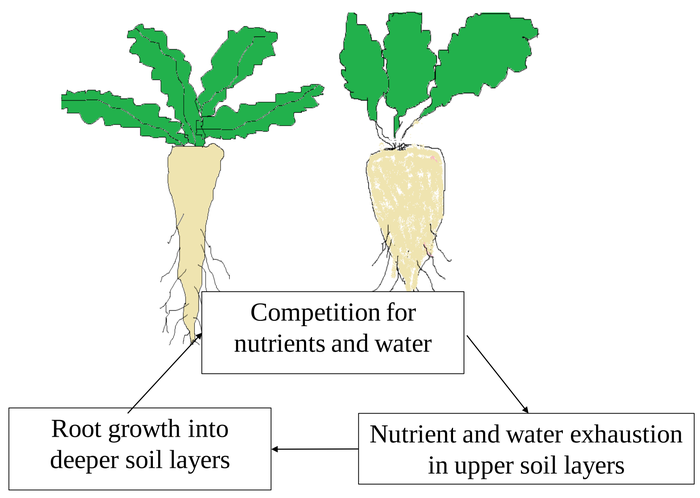
What are the benefits of deep-rooted crops?

Crops with deeper roots allow us to exploit unused nutrients and water from deep soil layers, and therefore to increase the sustainability of cropping systems. Deep roots improve agricultural soil quality (aggregation, hydraulic conductivity, porosity) due to soil penetration and higher organic matter input. These effects can also contribute to climate change mitigation through increased carbon storage in deeper soil layers where stored carbon may be more stable



How can we obtain crops with deeper roots?

In intercropping system component crops compete with each other for some time for the available resources, which exhausts nutrients in the top soil. However, root foraging strategies vary between species. Plants can overproduce roots in nutrient-rich areas in attempt to increase competitiveness. Thus, if one of the component crops is able to develop deep roots, such competition should enhance the deep-rooted crop for deeper root growth and enhance access to resources the lower soil profile.



Hypothesis

The intercropping enhances deep root growth and nutrient uptake compared to sole crops

Objectives

1. to study the rooting depth of a range of species in the Deep Root Lab
2. to elucidate the effect of intercropping on the deep root growth and nutrient uptake
3. to develop and test a new method quantifying deep-root uptake of nutrients

Deliverables

1. Deep root growth dynamics of sugar beet and chicory
2. Relationships between root growth, crop status, and uptake of nutrients from deep soil layers
3. Mixed intercropping as a tool to allow deep rooting and nutrient uptake

Intercropping study

This study has started in March, 2018. The design is a completely randomized block design with nine replicates. Seeds of sugar beet (*Beta vulgaris*) and chicory (*Cichorium intybus*) were germinated in the greenhouse and seedlings transplanted to the field (Fig. 1). Plants were grown as sole crops and as mixed intercrop. The plot size is 10 x 3.3 m. Inter- and intra-row distances are 25 cm (Fig. 2).

a) b) c)

Fig. 1 Seedlings of chicory (a) and sugar beet (b) grown in the greenhouse. Transplanting of the plants into the field (c).

a) b) c)

Fig. 2 Sole sugar beet (a), sole chicory (b), and sugar beet-chicory intercrop (c).

To determine the effect of the intercropping of the deep root growth, minirhizotron technique is currently being used to image roots (Fig. 3a). To evaluate the nutrient uptake, ingrowth core method with nutrient tracers will be used (Fig. 3b). Subsequently, roots of sugar beet and chicory will be quantified with amplicon sequencing (Fig. 3c).

a) b) c)

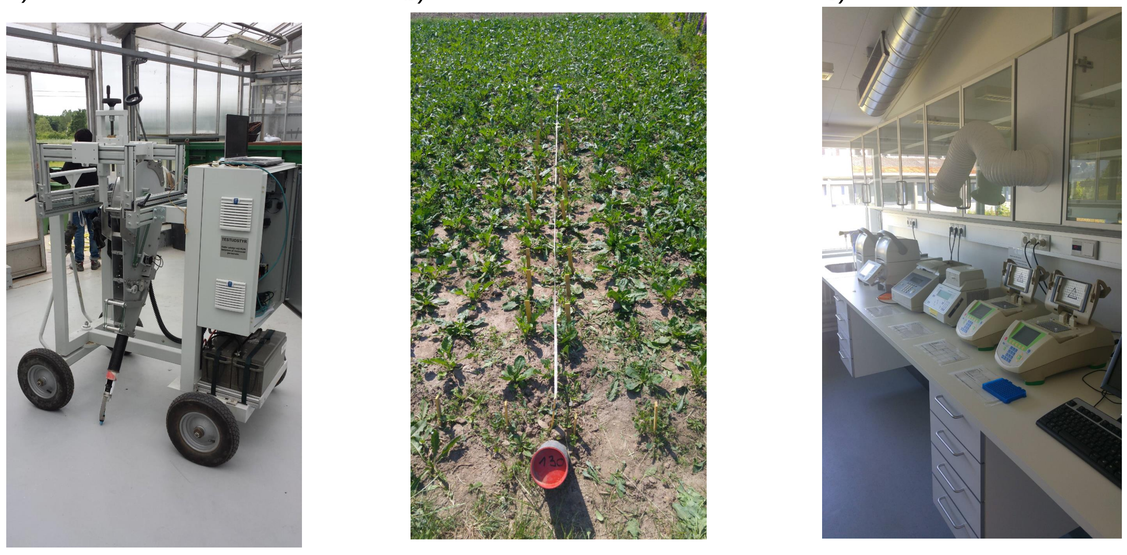
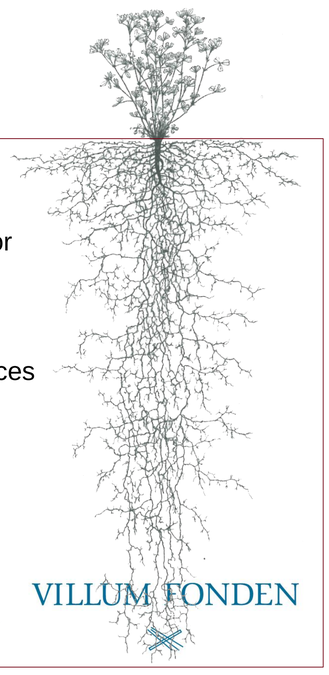


Fig. 3 Root imaging (a), ingrowth core (b), amplicon sequencing (c).



DeepFrontier

The DeepFrontier project is developing methods, facilities and ideas for future research into sustainable food production.

Our aim is to improve the understanding of deep rooting, i.e. what determines deep rooting, the activities of deep roots and which resources from deep soil layers are utilized by plants. The project will also study cropping systems with deep rooted species.

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