

## **Abstract**

The growing awareness of plant root importance has contributed to the continuous development of cultivation methods that facilitate more efficient and effective root research. Due to their sessile nature, plants rely extensively on roots for water and ion absorption (Meister et al., 2014). As a result, plant roots must adjust to an array of unfavorable conditions such as salinity, drought, and high temperatures.

To better understand root response and promote agricultural development, researchers simulate various stressors in controlled conditions. More recently developed transparent soils and soilless cultures aim to overcome the limitations of traditional soil cultivation, which include imprecise variable control, heterogeneous conditions, and destructive root sampling (Gregory et al., 2009). When planning an experiment, it is crucial to select an appropriate cultivation method to ensure success. The aim of this thesis is to provide a comprehensive overview of the benefits and limitations of commonly used cultivations techniques in plant stress research.

Transparent soil reliably mimics the mechanical properties of soil whilst allowing for easy root access and use of numerous visualization techniques. On the other hand, it still maintains the need for a larger cultivation area just like soil. The added disadvantage is increased price (H. Downie et al., 2012; Helen F. Downie et al., 2014). In contrast, soil-less techniques, namely hydroponics and aeroponics, allow for vertical cultivation, minimize space demands, and reduce water usage (Lakhiar et al., 2018; von Bieberstein et al., 2014). Their downsides are certain technical requirements and the inability to sustain all plant species. Both cultivation methods are, however, still evolving and have already facilitated research into numerous topics, including but not exclusive to, root microbiomes (Bergmann et al., 2016; O'Neill et al., 2014), root phenotypes (L. Ma et al., 2019; Nagel et al., 2009; Rascher et al., 2011), and effects of abiotic stressors (Kabiri et al., 2014; Li et al., 2019; Ye et al., 2003).