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Dissertation

Title *Development and Functioning of Mycorrhizal Root Systems under Non-Uniform Rootzone Salini-ty*

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Abstract The roots of most crop plants can become colonized by symbiotic arbuscular mycorrhizal (AM) fungi. These soil fungi form a dense network of hyphae around the root of their plant host. The AM myceli-um extracts the soil for nutritional elements, and transports and transfers them to the host plant. In return, the plant supplies the fungal partner with energy in form of hexose. So far only relatively little is known about the development and functioning of this symbiosis in sandy soils of the UAE, where plants are commonly exposed to complete or partial rootzone salinity or drought. The present study investigated the effect of root colonization by AM fungi on growth and nutrient uptake of tomato and Sudan grass plants exposed to topsoil salinity. The plants were grown in horizontal split-root contain-ers. Roots in the upper compartment were exposed to substrate salinity, while roots in the lower compartment had access to a non-saline nutrient solution. Despite roots being well-colonized by AM fungi, the relative contribution of the symbiosis to plant growth and nutrient uptake was small across all treatments. Salinity had a negative impact on plant growth, but not on the development of the my-corrhizal symbiosis. In another experimental approach, young clonal date palms were exposed to ele-vated salinity or reduced soil moisture, either affecting the whole root system, or only the upper or lower part of it. Horizontal split root containers were used for this study. Results of this experiment suggest that mycorrhizal date palms can well adjust to heterogeneous water availability in the rooting zone. Partial rootzone salinity, however, had a negative effect on plant growth. Another experimental approach aiming at investigating Prosopis spp. trees with grafted root systems could not be under-taken, as plants of this genus showed considerable graft incompatibility. A wide range of grafting techniques were tested. In vitro grafting approaches had the highest rates of success, and this tech-nique could be tested and developed further in future studies.

Research Relevance and Potential Impact

The findings presented broaden our understanding of how plant roots and associated symbiotic microorganisms respond to spatially limited soil salinity. The latter is a very common phenomenon in the UAE and other arid lands.
Based on the novel results of this study, innovative rootzone management practices, bearing the potential to sustain agricultural productivity in saline areas of the Gulf Region, could be developed.

Relevant Publications

- Asha Christopher & Elke Neumann. Insights on grafting incompatibility among Prosopis species. Arab Gulf Journal of Scientific Research (Under review).
- Asha Christopher & Elke Neumann. Effects of root exposure to spatially limited drought or salinity stress on growth characteristics, water use and nutrient uptake of mycorrhizal inoculated date palm (Phoenix dactylifera l.) (Under preparation).

Career Aspirations

The interdisciplinary effects of agricultural sciences will traverse a broad range of focal interests drawing in diversified natural resource management principles and practices for renewability of resources. Reminding the Bruntland Commission mission theme, "meeting the needs of the present ecosystem without compromising the ability of future generations to meet their own needs" is my lifetime objective. My area of future work would be focused on teaching the University students of the Arab world. My approach of educating and training the Arab students is unique. More importantly, I have conceived in my mind to pool-in research funds in the form of a mini-grant (from King Abdulaziz City for Science & Technology-KACST, Riyadh) at my Department of work. The area of research would be on discerning the effects of seaweed extracts (SWE) and humic acid on the salt, heat and growth physiology of Creeping bent grass, Agrostis stolonifera and the root-inoculated arbuscular mycorrhizal fungi site-specifically under desert-saline conditions will be investigated.