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“Utilisation of diversity in land use systems:
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Scale Specific Adaptations of Drought Responsive Systems

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Abstract

Water is an increasingly scarce resource and its availability is more and more erratic due to recent changes in rain fall patterns. Thus, agricultural systems suffer more often from drought or floods which leads to a demand for more flexible and plastic production systems. However, drought is a complex phenomenon that plants experience on a number of organisational levels or scales. Each scale can be viewed as an individual system, with specific adaptation potential to changing conditions. The highest organisation level is the agricultural system, followed by the field or individual crop scale. Down the line is the individual plant as a responsive system including tissue level systems as well as metabolic systems such as the proteome or the genome. This talk defines the different scales and their responsive potential, elaborates in examples the functioning of adaptation mechanisms on each scale and the interactions with factors other than drought influencing plant responses. The importance of long term and seasonal changes in the climatic environment, the effect and impact of erratic climatic events on the adaptation capacity of the respective system, responses to multiple stresses and varying degrees of stress severity are discussed using examples from recent experimental work. The requirements for modelling and in particular interfacing models for the different scales are elaborated. The talk concludes with the clear demand for inter- and multidisciplinary collaboration to better predict future changes in water availability and the plasticity of the respective systems. Developing a birds perspective in systems analysis without losing detailed expertise will expand the knowledge and thus exploitation potential of what is termed here as the gene-phene-scene continuum.

Keywords: Agricultural systems, climate change, gene-phene-scene-continuum, modelling, systems analysis