Influence of nitrogen supply and drought stress on the water use efficiency in potato

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Potato (*Solanum tuberosum L.*) is an important crop worldwide for food and non-food uses. Potatoes are produced commercially under various climatic conditions, including arid areas. In order to compensate for inadequate amounts and distribution of rainfall, irrigation systems are used in many potato-producing areas to ensure profitable yields and satisfactory quality. In particular, the tuber initiation stage is most sensitive to drought stress. Limited water availability in that phase can influence the number of tubers and subsequently yield. Many studies have shown that a balanced nitrogen (N) status alleviates drought stress by preventing cell membrane damage and by enhancing osmoregulation. In addition, sufficient N nutrition resulted in higher water use efficiency (WUE), as most of the leaf N is used to synthesize components of the photosynthetic apparatus, in particular RuBisCo playing a major role in carbon assimilation. However, plants with high photosynthetic capacity can consume more available water for the production of biomass. In contrast, water utilization is generally restricted in plants with low N levels and a decrease of WUE has been observed.
Both water- and N-deficiency induce many typical modifications in plants at the morphological and physiological level. The aim of the present study is to investigate such abiotic stress response in a number of potato cultivars and to identify divergent genotypes for further analysis of stress tolerances.
For this purpose a first pot experiment with two N-treatments and two water regimes was conducted in a rain-out shelter in 2013. Plants were supplied with 1040 mg total N in the control and with 260 mg in the N deficiency treatment. Well watered plants were kept at 60 % water capacity of the soil during the entire season, while plants of the drought treatment did not receive any water for 13 days in the tuber initiation stage. The trial comprised 14 commercial starch and three table potato varieties, which were tested in a randomized split-split-plot design.

Here we present first results of agronomic traits such as yield, WUE and N-content as well as physiological parameters including cell membrane stability (CMS), relative water content (RWC) and chlorophyll content (CC). Genotype dependent differences in the response to stress were observed. WUE and CMS decreased under drought- and N-deficiency stress. Furthermore, drought stress initially resulted in an increase in CC, especially under high N supply. While the cultivars did not show differences in RWC in relation to N supply, a significant impact of the water regime was observed. The determined physiological parameters will be correlated with the agronomic performance of the cultivars.