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"Bridging the gap between increasing knowledge and decreasing resources"

Effects of Drought Stress on Crop Development, Growth and Chlorophyll Fluorescence in Five Potato Clones

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Abstract

World food production increasingly faces problems due to increasing temperatures, extreme weather events, and climate change-related seasonal water scarcity. Potato is the fourth most important food crop in the world and susceptible to drought stress, due to its shallow root system. As potato production is often affected by water scarcity, identification of drought resistance traits will help the breeding/selection process to sustain potato production. The aim of this study was to investigate the effects of drought on plant growth and on carbon partitioning/tuber production in 5 potato clones from the advanced breeding population developed at the International Potato Center. A field experiment was conducted from August to November 2013 in the costal arid region in southern Peru. Five contrasting potato genotypes (392797.22, 301040.63, 392025.7, 397073.16, 397078.12) were subjected to 4 different irrigation treatments (i.e. fully watered, until 54 days after planting (DAP), 67 DAP, and 80 DAP respectively) in a "split-split plot" design. Destructive samplings and non-destructive measurements were conducted at ten day intervals in each treatment. At each date, chlorophyll fluorescence and SPAD measurements were taken and above and below ground biomass (leaves, stems, roots, and tubers) was sampled for all treatments. Since irrigation was withheld at different development stages, plants' transpirational capacity and thus stress severity experienced by the plant varied with the treatments. Late drought (withholding irrigation at 67 or 80 DAP, respectively) resulted in a more severe drought stress compared to early drought due to higher air temperature later in the season and increased leaf area. Nonetheless, across all genotypes total biomass reduction was rather related to drought duration then to stress intensity. Unexpectedly, this was accompanied by a decrease in quantum yield of PS II under drought stress which in turn was related to changes in SPAD values. Average and maximal root lengths, the importance of biomass partitioning for tuber growth as well as the link between stress severity and phenological stage with regard to the effects on biomass development and photosynthesis will be presented and discussed for genotype specific responses.

Keywords: Biomass partitioning, phenological stage, stress severity index

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