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Effect of Drought on Gas Exchange and Carbohydrate Metabolism in Pearl Millet

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Abstract

Two weeks old pearl millet plants (*Pennisetum glaucum* L.) were exposed for two weeks to severe drought in a climate chamber. A drought sensitive (841B) and a drought tolerant (Sadore) pearl millet genotype were exposed to the stress. Drought was induced by withholding water until the soil reached an pF value of 4.8, which was then maintained by watering the pots to a certain weight twice a day. The relative humidity was 40/60 % (day/night) and the light period was 12 h. After two weeks of drought treatment, the plants were harvested after 6 and 12 h of the light period and at the end of the night. In some of the plants which were harvested at the end of the night, several of the source leaves were removed at the beginning of the dark period. At harvest, the third leaf from the apex (leaf 3), the first leaf from the apex (leaf 1, still enclosed in the second leaf) and the fine roots were immediately frozen in liquid nitrogen.

The water potential of leaf 3 was more reduced in the sensitive genotype than in the tolerant genotype in response to drought. The net photosynthetic rate was strongly diminished by the drought treatment. Although drought decreased the stomatal conductance by more than 90 %, the decrease of the net photosynthetic rate was mainly caused by a reduction of the mesophyll conductance to CO₂.

Under drought the starch degradation during the night was hampered. This is an indication for a disturbed starch metabolism of the leaf and/or a strongly reduced sink activity under drought. The artificial alteration of the sink/source ratio allows indications about the role of the sink/source relation on the carbohydrate metabolism in response to drought.

Keywords: Carbohydrate metabolism, drought, gas exchange, pearl millet