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Mechanism of Interspecific Differences among Four Gramineous Crops in Growth Response to Soil Drying

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Abstract:
Drought tolerance is an important crop characteristic for maintenance of productivity under water deficit conditions. Interspecific differences among four gramineous crops (barnyard millet, maize, pearl millet and sorghum) in growth response to soil drying were studied. Seeds were sown in a sandy soil. Irrigation was stopped in some plots 16 days after sowing and was continued in others. Stopping irrigation increased resistance to water flow to between 2- and 21-fold. However, it decreased the soil water potential by -0.004 to -12.7 MPa, the relative growth rate (RGR) by 15 to 27%, the net assimilation rate (NAR) by 17 to 34% and the photosynthetic rate by 16 to 45%, respectively. Pearl millet and sorghum, which were identified as drought tolerant, displayed the lowest reductions in RGR. RGR was predominantly limited by NAR in all crops. The photosynthetic rate was preponderantly limited by stomatal conductance. Stomatal conductance correlated with leaf xylem water potential significantly. Pearl millet and sourghum showed the highest leaf water status. Root systems of all crops reached 140 cm soil depth. Under water stress, total root length was significantly reduced in maize, was not affected in barnyard millet, and was significantly increased in sorghum and pearl millet. Drought toleranace in sorghum and pearl millet was assoicated with sustained water uptake ability by increasing total root length and maintenance of high leaf water status under soil drying conditions at the vegetative growth stage.

Keywords:
Drought tolerance, Echinochloa framentacea Link., Pennisetum typhoideum Rich., Root, Sorghum bicolor Moench., Water stress, Water uptake ability, Zea mays L.

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