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Effects of the elevated atmospheric CO_2 concentration on the water use efficiency of winter wheat

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Abstract

In Central Europe drought is one of the most important limiting factor for autumn-sown cereals. Due to the decreasing in groundwater resources, it is a priority to make efficient use of groundwater and to promote less water-demanding forms of crop production. Water use efficiency can only be increased if cultivars with satisfactory water management traits are grown. To this end, water consumption (WU) and water use efficiency (WUE) of winter wheat genotypes were investigated in a greenhouse experiment. Plants were grown either with optimum water supply or with simulated drought in two phenophases, shooting and heading. Measurements were made on yield parameters, phenological traits and water use parameters of plants. This experiment was carried out in greenhouse chambers using the same climatic conditions, only the atmospheric CO_2 concentration was regulated. 400 ppm concentration was used as control and elevated levels were 700 and 1000 ppm, respectively. Water use efficiency was calculated by dividing the grain yield by the water used during the vegetation. Significant differences were determined by investigating the influence of water shortage on the water use efficiency of plants during the vegetation but also meaningful alterations were found among the drought and CO_2 sensitivity of varieties examined. Elevated CO_2 concentration improved the water use efficiency but there were some differences among the genotypes that could be followed not only by the control but also by the drought treated plants. Simulated drought stress by the shooting decreased the WUE compared to the well watered plants but there were meaningful differences among the varieties at the different CO_2 levels. The enriched CO_2 resulted in a significant increase of WUE under stress condition simulated by the heading compared to the plants grown under atmospheric CO_2 level.
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