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Elevated CO_2 (FACE) affects Food and Feed Quality of Cereals (Wheat, Barley, Maize): Interactions with N and Water Supply

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Abstract

Climate change will not only affect crop biomass production but also crop quality. While increasing atmospheric CO_2 concentrations are known to enhance photosynthesis and biomass production, effects on the chemical composition of plants are less well known. This is particularly true for major crop plants with respect to harvestable yield quality. Moreover, it remains open, how these effects on quality may be realized under field conditions and how management (e.g. plant N nutrition) or environmental factors (e.g. water availability) will alter impacts of elevated CO_2. Here we report on a series of free air CO_2 enrichment (FACE) experiments with wheat and barley and with maize in which effects of elevated CO_2 combined with different levels of N supply (wheat and barley) and with drought stress (maize) on grain and biomass quality characteristics were investigated. Winter wheat and winter barley (1st experiment) and maize (2nd experiment) were grown in the field each for two growing seasons under ambient and elevated CO_2 concentration (FACE, 550 µmol mol^{-1}). Wheat and barley were grown under adequate N supply and under 50% of adequate N as sub-treatments. In the maize experiment rain shelters were used to create two different levels of plant water supply (well-watered and drought stress – about 50% of well-watered) as sub-treatments. Treatment effects on elemental composition and a variety of quality characteristics of the plant material at final harvest were investigated. This included a detailed analysis of wheat grain protein components and of different fiber fractions of maize.

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Compiled results of the relative effects of elevated CO_2, N and drought stress treatments on different quality parameters of the crops are presented.

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Keywords: Winter Barley; Maize; Winter Wheat; Quality; Elemental Composition; Minerals; Fibers; Protein Composition; Carbon Dioxide; Drought Stress; Nitrogen Supply; Field Experiment; Climate Change