Effects of free-air CO_2 enrichment on energy traits and seed quality of oilseed rape

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Abstract

Previous experiments have not considered in situ evaluations of CO_2 enrichment on oilseed rape (OSR) under European climates with regard to energetic value and seed quality. Therefore, *Brassica napus* cv. Campino was grown in a free-air CO_2 enrichment (FACE) field experiment at Stuttgart-Hohenheim (Germany) under ambient (388 ± 9 µl l^{-1}) and elevated (494 ± 16 µl l^{-1}) CO_2 concentrations. Aboveground biomass production and energy yields of both straw and seeds increased, while energy contents per dry weight were identical in both CO_2 treatments. Among the mineral concentrations in seeds, sulphur, boron and cadmium were significantly reduced and zinc and manganese tended to decrease ($0.1 \geq P > 0.05$) under elevated CO_2. Total protein concentration declined significantly by 4.6% with CO_2 enrichment, although increased seed yield (+18.4%) compensated for the change on a production basis. Accordingly, several proteinogenic amino acids per unit meal weight were significantly reduced (asparagine/aspartic acid, glycine, alanine, cysteine, valine, isoleucine, and leucine) or tended to decrease (glutamine/glutamic acid, methionine) in the high-CO_2 treatment, resulting in higher carbon/nitrogen ratios. Amino acids on a per protein basis and total oil concentrations were unaffected, while oil yield per unit ground area tended to increase by 19.8%. Elevated CO_2 slightly changed the composition of fatty acids on a per dry weight basis, which was more pronounced for unsaturated fatty acids. The concentration of major unsaturated fatty acids such as oleic acid increased significantly, while linolenic acid, nervonic acid and the group of essential fatty acids were decreased. There was also a negative trend for cis-11-eicosenic acid. The same holds true for the composition of fatty acids on a per oil basis. Among glucosinolates, only progoitrin tended to decrease under CO_2 enrichment. The results indicate that elevated CO_2 levels may have implications for food and feed quality and use for industrial processing of OSR in the future..

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