Abstract

Effects of anticipated future concentrations of ozone (O_3) and carbon dioxide (CO_2) on potato (*Solanum tuberosum* L., cv. Bintje and Kardal) yield and tuber quality were examined. The crop was exposed to controlled levels of O_3 and CO_2, using open-top chamber (OTC) technique. The experiments were performed within the Swedish participation in the EU programme *Changing climate and potential impact on potato yield and quality* (CHIP). For some effect variables, the dataset was extended to include the Finnish CHIP experiment of 1998. The O_3 exposure of the growing plants had a significant negative impact on potato tuber dry mass production. The O_3 induced reduction in tuber dry mass yield was related to an O_3 induced reduction in the number and duration of green leaves. The O_3 induced yield reduction was partly explained by a reduced number of tubers and associated with reductions in starch and macronutrient offtakes per unit field area. The potato cultivar with a determinate growth pattern (Bintje) was suggested to be more sensitive to O_3 induced biomass reductions than the cultivar with a less determinate growth pattern (Kardal). O_3 reduced the tuber concentrations of glucose and fructose, which may indicate an O_3 induced early maturity. Also the O_3 effects on the two most abundant organic acids in potato tubers were in accordance with an O_3 induced early maturity, i. e. an increase in citric acid concentration and a decrease in malic acid concentration. The O_3 effects on tuber concentrations of citric and malic acids may partly be mediated by an O_3 induced increase in tuber K concentration. The tuber concentrations of N, P, K and Mg tended to be positively related to the O_3 exposure of the growing plants, while the Ca concentration remained largely unaffected. Also these effects were suggested to be due to O_3 induced early haulm senescence. In addition, an O_3 induced change in the relation between carbon assimilation and total macronutrient uptake may have contributed to the increase in tuber N, P, K and Mg concentrations. O_3 was shown to decrease the tuber dry matter content in one of the three investigated experiments. Elevated CO_2 induced an increase in tuber number per plant. This effect could not be demonstrated to be associated with an increase in tuber dry mass yield or with any mitigation of O_3 induced tuber yield loss. CO_2 was considered to be more potent to alter growth patterns and other physiological traits than to stimulate biomass production. Any CO_2 induced increase in potato tuber dry mass production was suggested to be dependent on favorable growth conditions. Elevated CO_2 did not, by itself, affect the dry matter composition of the tubers, but tended to prevent O_3 induced effects on the tuber concentrations of reducing sugars and macronutrients.

Keywords: *Bintje; carbohydrate; carbon dioxide; citric acid; cultivar; fructose; glucose; Kardal; macronutrient; malic acid; mineral; open-top chamber; OTC; ozone; potato; Solanum tuberosum; starch; variety; yield*