Complex interplay of future climate levels of CO2, ozone and temperature on susceptibility to fungal diseases in barley.

Barley (Hordeum vulgare) was grown in different climatic environments with elevated [CO2] (700 vs 385 ppm), [O3] (60/90 vs 20 ppb) and temperature (24/19 vs 19/12°C day/night) as single factors and in combinations, to evaluate the impact of these climatic factors on photosynthesis and susceptibility to powdery mildew and spot blotch disease. No significant increase in net CO2 assimilation rate was observed in barley grown under elevated [CO2] at ambient temperature. However, this rate was positively stimulated under elevated temperature together with a slightly higher potential quantum efficiency of PSII, both at ambient and elevated [CO2], suggesting that photosynthesis was not limited by [CO2] at ambient temperature. When growing under elevated temperature or [O3], infection by the biotrophic powdery mildew fungus decreased, whereas disease symptoms and growth of the toxin-secreting hemibiotrophic spot blotch fungus increased compared to ambient conditions, implying that climate-induced changes in disease severity could be linked to the trophic lifestyle of the pathogens. Elevated [CO2] decreased powdery mildew infection but had no effect on spot blotch disease compared to ambient condition. However, the effect of elevated [CO2], [O3] and temperature did not act in an additive manner when combined. This led to a surprising disease development in the combination treatments, where powdery mildew infection increased despite the individual reducing effect of the climatic factors, and spot blotch disease decreased despite the individual promoting effect of temperature and ozone, emphasizing the importance of conducting multifactorial experiments when evaluating the potential effects of climate change.