

Science for Environment Policy

Severity of wheat diseases likely to increase as CO₂ rises

Rising levels of atmospheric CO₂ will increase the severity of wheat diseases, reducing yields and threatening food security, a new study suggests. Researchers found that levels of two common wheat diseases increased significantly when plants were grown with elevated CO₂. Furthermore, disease levels were even worse when the plants and pathogens had been acclimatised to the higher concentrations of CO₂ beforehand.

Wheat is a staple food for large parts of the world and, to meet the typical demands of a growing population, it is estimated that production must at least double by 2050.

However, food security is far from assured on our changing planet. Rapidly rising CO₂ and the resultant [changes to the climate](#) can affect agricultural crops in different ways, with impacts on both the plants and their pests.

For this study researchers investigated the effects of elevated CO₂ on two common wheat diseases, *Fusarium* head blight (FHB), which attacks flowers, and *Septoria tritici* blotch (STB), which infects leaves. STB epidemics can reduce wheat yields by half and collectively farmers invest more than \$700 million (€614 million) in chemical control agents every year. FHB also reduces yields and in addition can contaminate wheat grains with harmful toxins.

Importantly, the researchers examined the impact of elevated CO₂ on the diseases once both the plants and pathogens had been acclimatised to the new conditions. Initially, some plants were grown under elevated CO₂ at concentrations of 780 parts per million by volume (ppmv)¹. Others were grown at ambient concentrations of 390 ppmv. Once seed was produced it was harvested and used to grow plants for the final experiments. Similarly, the pathogens were cultured under elevated or ambient conditions for multiple generations prior to the disease trials.

In the final experiments the wheat plants were grown either under elevated or ambient CO₂ and were infected with one of the two diseases. The researchers then assessed the development of the disease.

The results showed that elevated CO₂ increased the severity of both diseases. Furthermore, acclimation of the pathogens and the plant worsened disease development. For example, for FHB, the highest disease levels were found for plants that had been acclimated under elevated CO₂ infected by pathogens that had also been acclimated at elevated levels. This combination caused significant reduction in yields; the number of grains was reduced by 76% and the weight of grain by 59%. Even if the final experiment was conducted under ambient conditions the pathogens that had been acclimated to elevated CO₂ caused 36% more disease than those acclimated to ambient conditions.

The researchers also tested a second strain of wheat, specifically bred to be resistant to FHB. Again, elevated CO₂ increased the severity of the disease. FHB levels were 28% higher in wheat grown in elevated CO₂ than those under ambient CO₂ (for plants and pathogens both acclimated to elevated CO₂). In this situation the number of grains produced was also 27% lower and the weight 20% lower.

These results are worrying, the researchers say, since they indicate that as climate change progresses epidemics of these diseases will become more common, threatening food security. Furthermore, the fact that CO₂ concentrations are rising sharply means plants do not have enough time to evolve defences against their pathogens. Breeding programmes to produce wheat strains that can cope with these altered conditions should begin immediately, the authors recommend.



11 June 2015

Issue 416

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Source: Váry, Z., Mullins, E., McElwain, J. C. & Doohan, F. C. (2015). The severity of wheat diseases increases when plants and pathogens are acclimatized to elevated carbon dioxide. *Global Change Biology*. Early online. DOI: 10.1111/gcb.12899.

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To cite this article/service: "Science for Environment Policy": European Commission DG Environment News Alert Service, edited by SCU, The University of the West of England, Bristol.

1. Corresponding roughly to the levels predicted by the IPCC A2 emission scenario for the year 2100.