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The optimal atmospheric CO_2 concentration for the growth of winter wheat (*Triticum aestivum*)

This study examined the threshold of CO_2 fertilization effect on the growth of winter wheat with five growth chambers where the CO_2 concentration was controlled at 400, 600, 800, 1000, and 1200ppm respectively. I found that initial increase in atmospheric CO_2 concentration dramatically enhanced winter wheat growth through the CO_2 fertilization effect. However, this CO_2 fertilization effect was substantially compromised with further increase in CO_2 concentration, demonstrating a threshold (the optimal CO_2 concentration) of 889.6, 909.4, and 894.2ppm for aboveground, belowground, and total biomass, respectively, and 967.8ppm for leaf photosynthesis. Also, high CO_2 concentrations exceeding the threshold not only reduced leaf stomatal density, length and conductance, but also changed the spatial distribution pattern of stomata on leaves. The spatial patterns of stomata were scale-dependent, a pattern of regularity at scales below about 150 micrometers, clustering beyond 220 micrometers, and random between the two scales. Elevating CO_2 concentration led to more regular patterns of stomatal distribution at small scales (<150 micrometer), but little effect was detected on the clustering patterns at large scales (>220 micrometers). In addition, high CO_2 concentration also decreased the maximum carboxylation rate (Vcmax) and the maximum electron transport rate (Jmax) of leaf photosynthesis. However, the high CO_2 concentration had little effect on leaf length and plant height. The results indicate that climate change assessment models may overestimate the CO_2 fertilization effect and, thus underestimate the potential threats of climate change on agriculture when atmospheric CO_2 concentration exceeds the threshold. The threshold of CO_2 fertilization effect found in this study can also be used as an indicator in selecting and breeding new wheat strains in adapting to future high atmospheric CO_2 concentrations and climate change.

Biography

Ming Xu has completed his PhD in 2000 from the University of California at Berkeley and Postdoctoral studies from the same university in 2015. He is an Associate Professor at Rutgers University and an Adjunct Professor with the Chinese Academy of Sciences. His research has focused on global change ecology and process-based ecosystem modeling. He has published more than 100 peer-reviewed papers in the leading journals of his fields and dozens of books and book chapters. He has been serving as an Editorial Board Member of the *Journal of Plant Ecology.*

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