Rising carbon uptake and sequestration but declining carbon allocation to biomass production and grain yield in a high-yield agroecosystem

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Abstract

Photosynthetically carbon (C) allocation largely determines yield and C sequestration of agroecosystem. However, how C allocation of crops responses to climate change at the long-time scale is poorly defined. Combining thirteen years of eddy covariance and inventory measurements, we comprehensively investigated C allocation mechanism in a winter-wheat and summer-maize double cropping field. Significantly increased gross primary production (GPP) was benefited from CO2 fertilization, and 35% of increased GPP transferred to strengthening C sequestration. However, elevated temperature and drying surface soil moisture stimulated the partitioning of GPP to autotrophic respiration, resulted in conservative net primary production and grain yield. Maize faced a greater risk of C loss and yield reduction than wheat to warming and drying. By synthesizing published long-term data of agroecosystems, we further highlight that the GPP partitioning cannot be simply predicted by allometric theory, particularly for grains, which should be considered in predicting C budget and crop yield.

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