PREDICTING CLIMATE CHANGE IMPACTS ON SUGARCANE PRODUCTION AT SITES IN AUSTRALIA, BRAZIL AND SOUTH AFRICA USING THE CANEGRO MODEL

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Abstract

Future climate change is expected to have important consequences for sugarcane production, and reliable predictions of crop response to climate change are necessary to plan adaptation strategies. The objective of this study was to assess the use of global climate models (GCMs) and a crop simulation model for predicting climate change impacts on sugarcane production.
The Canegro model was used to simulate growth and development of sugarcane crops under typical management conditions at three sites (irrigated crops at Ayr, Australia; rainfed crops at Piracicaba, Brazil and La Mercy, South Africa) for current and three future climate scenarios. The baseline scenario consisted of a 30-year time series of historical daily weather records and atmospheric CO_2 concentration ([CO_2]) set at 360 ppm. Future climate scenarios were derived from three GCMs for the A2 greenhouse gas emission scenario and [CO_2] set at 734 ppm. The three GCMs were chosen to represent the uncertainty in projected rainfall changes.
Future cane yields are expected to increase at all three sites, ranging from +4% for Ayr, to +9% and +20% for Piracicaba and La Mercy. The uncertainty of these predictions correlates with the magnitude of the predicted yield increase. Canopy development was accelerated at all three sites by increased temperature, which led to increased interception of radiation, increased transpiration, and slight increases in drought stress at rainfed sites. For the high potential sites (Ayr and Piracicaba), yield increases were limited by large increases in maintenance respiration which consumed most of the daily assimilate when high biomass was achieved. A weakness of the climate data used was the assumption of no change in rainfall distribution, solar radiation and relative humidity – variables that are crucial in determining the water status of rainfed sugarcane. Crop model aspects that need refinement include improved simulation of (1) elevated [CO_2] effects on crop photosynthesis and transpiration, and (2) high temperature effects on crop development, photosynthesis and respiration.

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