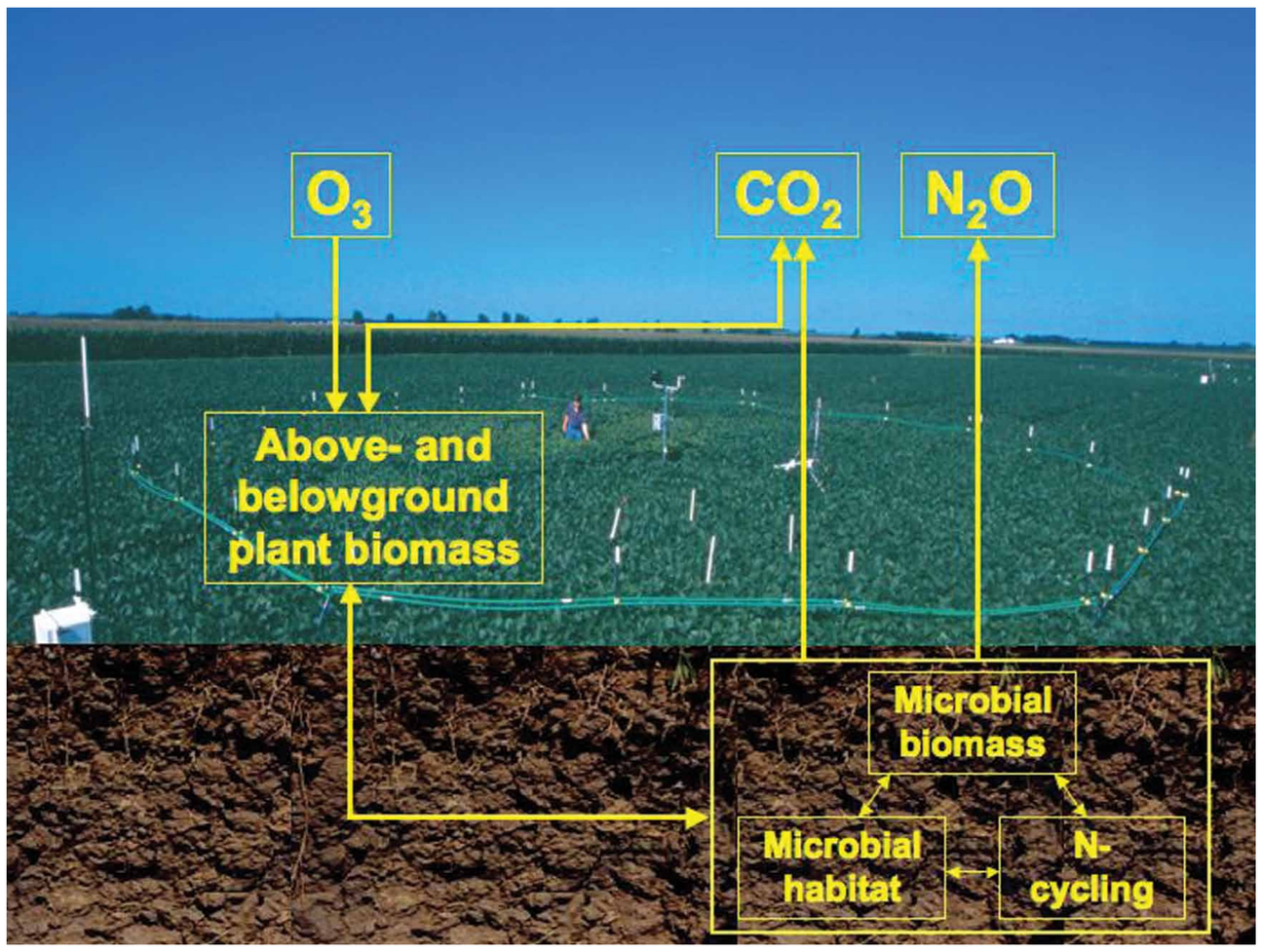
SUSTAINABLE FOOD AND AGRICULTURE

# Effects of Elevated $CO_2$ and $O_3$

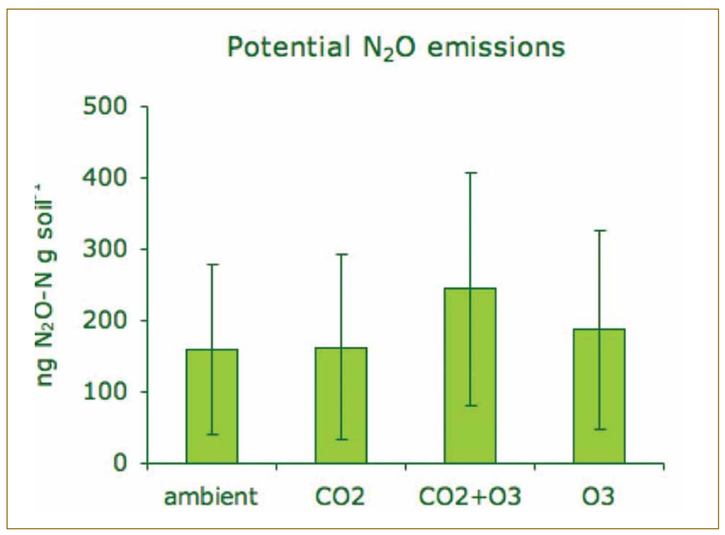
## By understanding soil-plant-atmosphere interactions, global climate change and future plant nitrogen availability feedbacks are predictable.

NITROGEN IS AN IMPORTANT plant nutrient, but plant nitrogen availability depends on the form nitrogen takes in the soil. Key nitrogen transformations are carried out by soil microorganisms. Nevertheless, certain microorganisms produce nitrous oxide ($N_2O$), a gaseous form of nitrogen and a potent greenhouse gas.

Predicted concentrations of atmospheric carbon dioxide ($CO_2$) and tropospheric ozone ($O_3$), both of which are greenhouse gases, can cause changes in plant growth, which in turn affects soil microbial habitat and soil nitrogen transformation rates. We investigated complex soil-plant-atmosphere interactions in a soybean agroecosystem in Illinois exposed to elevated $CO_2$ and $O_3$. Understanding these interactions is important to predict feedbacks on global climate change and future plant nitrogen availability (hence food security).

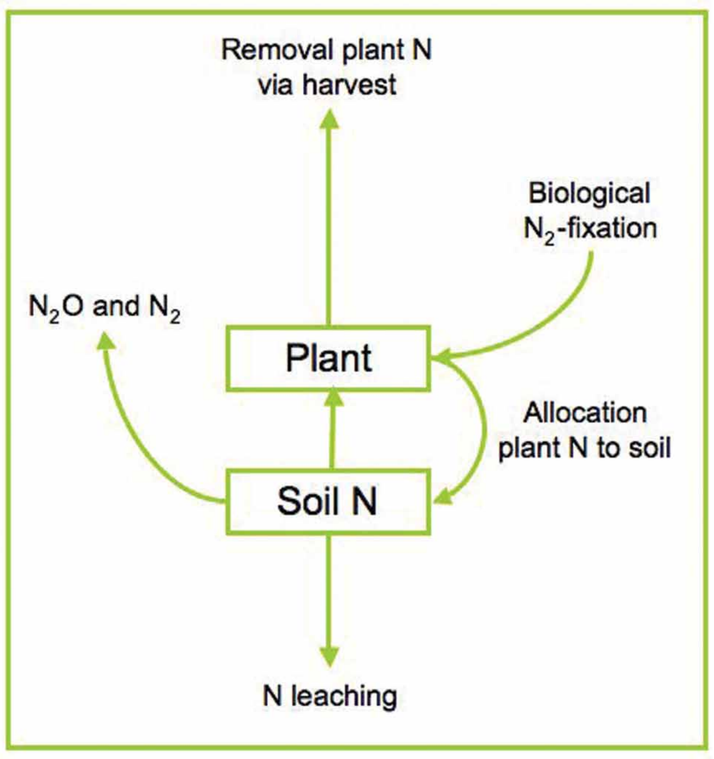


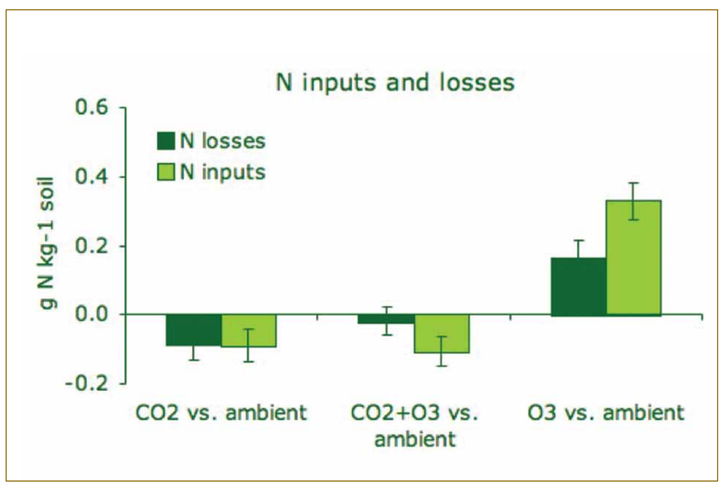

▲ Elevated $CO_2$ and $O_3$, both of which are greenhouse gases, affect plant growth, which in turn alters soil microbial habitat. Consequently, the activity of $N_2O$-producing soil microorganisms can be affected. Because $N_2O$ is a potent greenhouse gas, this can result in a feedback of elevated $CO_2$ and $O_3$ on global climate change.




▲ $N_2O$ emissions from soil collected from a soybean field exposed to elevated $CO_2$ and $O_3$. The soil was incubated under laboratory conditions for 28 days to assess the potential effect of elevated $CO_2$ and $O_3$ on $N_2O$ emissions. No differences between the treatments were observed, indicating that elevated $CO_2$ and $O_3$ will not cause a feedback on global climate change via altered $N_2O$ emissions in this system.

Nitrogen inputs in the system are realized through biological $N_2$-fixation. Micro-organisms live in symbiosis with the plant and transform atmospheric $N_2$ into plant available nitrogen. Nitrogen is lost from the system through harvest, gaseous loss and nitrogen leaching to the ground water. ▶




▲ Elevated $CO_2$ and elevated $CO_2$+$O_3$ tend to decrease nitrogen inputs and outputs, whereas elevated $O_3$ increases nitrogen inputs and outputs. As a result, a new equilibrium is reached. Therefore, elevated $CO_2$ and $O_3$ do not affect the net nitrogen budget of the system.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