



Researchers are growing wheat under artificially increased concentrations of carbon dioxide to see how atmospheric change will influence crop production.

PHOTO: DR GLENN FITZGERALD

TURN AND FACE THE CHANGE

The predicted increase in carbon dioxide concentration could influence future crop productivity **By Michael Tausz**

ELEVATED ATMOSPHERIC CO₂ MAY INCREASE GROWTH, YIELD AND DEMAND FOR SOIL NUTRIENTS.

BY 2050, IT is predicted that the concentration of carbon dioxide (CO₂) in the Earth's atmosphere will have increased to 550 parts per million (ppm). That is an increase of 70 per cent from the current levels of 390 ppm. Carbon dioxide is a potent greenhouse gas but is also a vital component of all life. Researchers are trying to establish how this change in CO₂ concentration will affect crop production.

Carbon dioxide is the main substrate for photosynthesis, the process by which green plants convert solar energy into biomass. To date, most experiments on the effects of elevated CO₂ concentrations on plant growth have been done in climate chambers or greenhouses.

The use of a Free Air Carbon Dioxide Enrichment Array (FACE) is enabling researchers to test the impacts of increased CO₂ on plants growing in the field.

The FACE project is located in Horsham, Victoria. Two wheat varieties, Janz and Yitpi[®], are being grown inside a series of rings in which the level of CO₂ in the air around the plants can be artificially elevated to 550 ppm.

Yitpi[®] was selected as it is a widely grown variety in the trial areas, while Janz is a variety with wide appeal across Australia.

Treatments include elevated and current CO₂ concentrations across the two varieties under rain-fed or irrigation, two fertiliser treatments, and late and early sowing dates. The trials are replicated for three years.

The 2008 and 2009 data from the Horsham site is still being analysed. The 2007 results from Horsham showed that with elevated levels of atmospheric CO₂:

- the number of kernels per spikelet increased;
- the rate at which crops matured (called 'phenology') was not affected;
- average crop biomass increased by 20 per cent;

- the ratio of grain weight to total plant weight (called the 'harvest index', a measure of the efficiency of the plant to produce grain) was not affected;
- grain yield increased by 12 per cent for rain-fed crops and by 24 per cent for irrigated crops;
- the application of nitrogen had no effect;
- there was little difference in growth between wheat varieties being tested (Yitpi[®] and Janz); and
- grain protein content was reduced by, on average, 0.5 per cent.

Although the effects of increased CO₂ generally appear positive, the data is still limited. There are concerns that there may be a trade-off between increased growth and diminished stress tolerance of grain grown in higher concentrations of CO₂.

Additionally, lower grain-protein content has potential ramifications for human nutrition. Although grain-protein contents were lower, total nitrogen uptake was increased due to increased biomass. This creates the potential of increased fertiliser use.

As a parallel part of the project, researchers at the Victorian Department of Primary Industries (DPI) are assessing the changes that increased atmospheric CO₂ might have on the spread of pests and diseases.

Entomologist Piotr Trebicki is studying the oat aphids that fly into the FACE rings. These aphids are one of the main vectors for the spread of barley yellow dwarf virus (BYDV).

This work is looking at whether the increased levels of CO₂ change how the aphids acquire and transmit the virus, as well as any changes in the severity of BYDV and other pathogens.

In 2010, the project will begin a multi-year study to look at the effects of elevated CO₂ on a wheat/field pea rotation, using various varieties of both crops. This will enable an increased understanding of the effect of elevated CO₂ on legumes and nitrogen fixation, which is poorly understood. Knowledge gained could influence future nitrogen fertiliser management.

Information from the experiments will be shared with crop modellers and plant breeders to help prepare Australian broadacre farmers for the future. □

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