



Forest ecosystems elevated CO₂ project

Globally, the atmospheric concentrations of carbon dioxide (CO₂) and other greenhouse gases are increasing, resulting in climate change. The consensus is that a doubling of the atmospheric CO₂ concentration and an increase in mean annual temperature approaching 3 °C are likely to occur by the late part of the next century. Large-scale planting of forests offer the potential to mitigate the effects of climate change by their uptake and storage of carbon to offset the increase in CO₂ concentration.

This unique, long-term field experiment will determine the magnitude of the effects of elevated CO₂ concentration and temperature, and their interactions, on the

- increased uptake and storage of carbon by forest ecosystems and the
- physiological and biochemical processes of growth, productivity and wood quality.

The New Zealand Forest Research Institute and Manaaki Whenua – Landcare Research are collaborating on this project to grow *Pinus radiata* and *Nothofagus fusca* (red beech) trees for up to four years

in the conditions predicted to occur toward the end of the next century. The trees will be grown in 16 large open-top chambers in which the CO₂ concentration and temperature will be maintained at ambient conditions, or elevated. Each open-top chamber consists of an aluminium framework, 4.5 m tall and 3.6 m in diameter, supporting plastic panels. A large fan forces air into a double layered plenum at the base of the chamber, where the air is mixed, passes through holes into the chamber and out the top. A frustum at the top narrows the air flow out of the chamber and limits the intrusion of outside air. The top is open, so the trees grow in conditions as close to those in the natural environment as possible. Control plots, with no chamber, are also included in the experimental design.

A large quantity of CO₂ is required to maintain the elevated concentration in the chambers. This has been affordable by siting the project adjacent to the Christchurch City Council's Sewage Treatment Works, where the CO₂ is being separated from waste biogas. Installation

of the open-top chambers at the site is nearing completion and it is expected that the chambers will be operational and the system tested by the end of June.

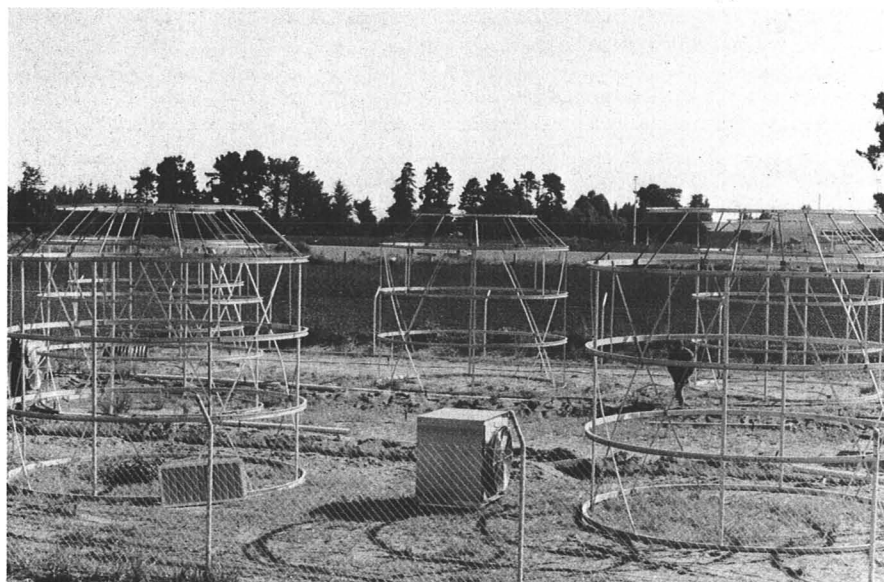
During the last year, considerable effort has been put into preparing unique tree material for this project. Tissue culture techniques have been used to propagate juvenile and mature clonal *Pinus radiata*, and seedlings from the same families have been grown, to allow comparisons between physiological ages and stages of development to be made. The trees, which are growing currently at ambient and elevated CO₂ concentrations in controlled environment facilities, will be transferred to the chambers in July.

International collaboration has been an important contribution to this project. Tissue culture techniques to propagate clonal material at elevated CO₂ concentration were developed in association with the University of Chiba, Japan. The chambers have been provided by the USDA Forest Service, North Carolina, USA and the experimental design and programme of measurements have been developed and will be undertaken in collaboration with the University of Georgia, USA, the Federal Agricultural Research Centre, Braunschweig, Germany and the European Commission EPOCH Project. The project is an official contribution to the core research programme of the GCTE (Global Change and Terrestrial Ecosystems) component of IGBP (International Geosphere-Biosphere Programme).

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Installation of the open-top chambers at the site at Bromley, Christchurch. The aluminium frameworks for the 16 chambers are in position and each will be equipped with a fan box as shown. The network of piping is being installed underground. When this is completed, the plastic panels will be fitted to each chamber. In the distance on the right is the Sewage Treatment Works, from which the carbon dioxide for the study is being provided.