

Research review
Elevated CO₂ and conifer roots: effects on growth, life span and turnover

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Summary Elevated CO₂ increases root growth and fine (diam. ≤ 2 mm) root growth across a range of species and experimental conditions. However, there is no clear evidence that elevated CO₂ changes the proportion of C allocated to root biomass, measured as either the root : shoot ratio or the fine root : needle ratio. Elevated CO₂ tends to increase mycorrhizal infection, colonization and the amount of extrametrical hyphae, supporting their key role in aiding the plant to more intensively exploit soil resources, providing a route for increased C sequestration. Only two studies have determined the effects of elevated CO₂ on conifer fine-root life span, and there is no clear trend. Elevated CO₂ increases the absolute fine-root turnover rates; however, the standing crop root biomass is also greater, and the effect of elevated CO₂ on relative turnover rates (turnover : biomass) ranges from an increase to a decrease. At the ecosystem level these changes could lead to increased C storage in roots. Increased fine-root production coupled with increased absolute turnover rates could also lead to increases in soil organic C as greater amounts of fine roots die and decompose. Although CO₂ can stimulate fine-root growth, it is not known if this stimulation persists over time. Modeling studies suggest that a doubling of the atmospheric CO₂ concentration initially increases biomass, but this stimulation declines with the response to elevated CO₂ because increases in assimilation are not matched by increases in nutrient supply.