CO_2 enrichment increases carbon and nitrogen input from fine roots in a deciduous forest

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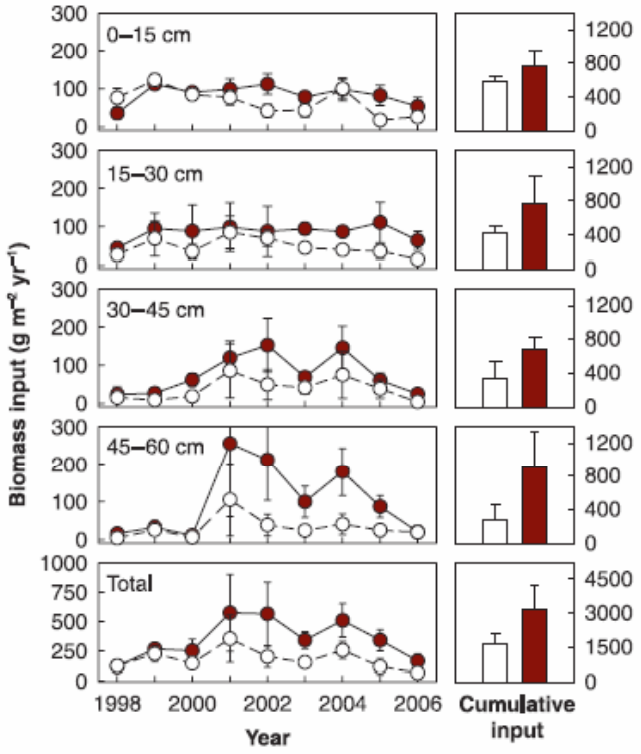
- We assessed the effect of elevated [CO_2] on production and mortality of short-lived fine-root populations at several soil depths in a CO_2-enriched sweetgum (*Liquidambar styraciflua)* plantation.
- CO_2 enrichment doubled root production and mortality over 9 years, resulting in 681 g m^{-2} of extra carbon and 9 g m^{-2} of extra nitrogen input to the soil system.
- Half of the C and N inputs were in deep soils below 30 cm.
- Increased carbon and nitrogen input to soils under CO_2 enrichment may alter normal soil carbon storage and nitrogen mineralization.
- Potential carbon storage in protected deep soil pools deserves further attention.



Average annual and cumulative root biomass inputs were greater under elevated [CO_2], especially at depth in the soil.

Reference: Iversen CM, Norby RJ, and Ledford J (2008) CO_2 enrichment increases carbon and nitrogen input from fine roots in a deciduous forest. New Phytologist 179: 837-847.

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The production of fine roots (less than 2 mm in diameter) is expected to increase under elevated atmospheric [CO_2], especially in N-limited forests where increased belowground C allocation may facilitate nitrogen N acquisition. Greater fine-root production under elevated [CO_2] may drive changes in soil C storage and N cycling because fine roots turnover quickly in forested ecosystems. However, the rate at which C and N are re-mineralized from fine-root detritus will depend on root population turnover and chemistry, and the soil depth at which the roots are produced. We assessed the effect of elevated [CO_2] on fine-root biomass and N inputs at several soil depths using a long-term minirhizotron data set combined with continuous, root-specific measurements of root mass per unit length and [N]. We conducted our research at the Oak Ridge National Laboratory (ORNL), Free-Air CO_2-Enrichment (FACE) experiment in a sweetgum (*Liquidambar styraciflua* L.) plantation in eastern Tennessee, USA where the sweetgum trees had been exposed to current or elevated atmospheric [CO_2] for 9 years. CO_2-enrichment had no effect on fine-root tissue density or [N] within a given diameter class. Fine-root biomass production and peak standing crop doubled under elevated [CO_2]. Though fine-root population turnover was somewhat slower under elevated [CO_2], fine-root mortality was also nearly doubled under CO_2-enrichment. Over 9 years, fine-root mortality resulted in 681 g m^{-2} of extra C and 9 g m^{-2} of extra N input to the soil system under elevated [CO_2] relative to the current [CO_2] treatment. At least half of these inputs were below 30 cm soil depth where the microbial mineralization of C and N from fine-root detritus may be limited by soil temperature, oxygen availability, or moisture. Quantification of the effects of elevated CO_2 on fine-root detritus and its subsequent decomposition, especially at depth in the soil, will provide critical information needed for predicting processes such as long-term soil C storage and N cycling in response to environmental change.

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