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The outcome of ecosystem manipulation by elevating atmospheric CO_2 is influenced by tree identity and mixture

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Free Air Carbon dioxide Enrichment (FACE) has often been used predict the response of forest ecosystems to a future high CO_2 world. Many of these investigations have been restricted to exposure of single species or genotypes to elevated CO_2. To investigate the interaction between tree mixture and elevated CO_2, Alnus glutinosa, Betula pendula and Fagus sylvatica were planted in areas of single species and a three species polyculture in a free-air CO_2 enrichment study (BangorFACE). The trees were exposed to ambient or elevated CO_2 for 4 years. Aboveground woody biomass was increased in polyculture under both ambient and elevated CO_2, but the response to elevated CO_2 was smaller in polyculture than in the monocultures. In some years, a longer leaf retention was shown under high CO_2, and is an indication that environmental factors may moderate tree response to high CO_2. Fine and coarse root biomass, together with fine root turnover and fine root morphological characteristics were also measured. Fine root biomass and morphology responded differentially to the elevated CO_2 at different soil depths in the three species when grown in monocultures. In polyculture, a greater response to elevated CO_2 was observed in coarse roots, and fine root area index. Total fine root biomass was positively affected by elevated CO_2 at the end of the experiment, but not by species diversity. Our results show that the aboveground and belowground response to elevated CO_2 is significantly affected by intra- and inter-specific competition, and that elevated CO_2 response may be reduced in forest communities comprised of tree species with contrasting functional traits but also that other environmental factors may induce previously unseen effects.