

Atmospheric dynamics of combined crops of wheat, cowpea, pinto beans in the Laboratory Biosphere closed ecological system

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A mixed crop consisting of cowpeas, pinto beans and Apogee ultra-dwarf wheat was grown in Laboratory Biosphere, a 40 m³ closed life system equipped with 12000 watts of high pressure sodium lamps over planting beds with 5.37 m² of soil. Similar to earlier reported experiments, the concentration of carbon dioxide initially increased to 7860 ppm at 10 days after planting due to soil respiration plus CO₂ contributed from researchers breathing while in the chamber for brief periods before plant growth became substantial, fell rapidly as plant growth increased up to 29 days after planting and then was maintained mostly in the range of about 200 – 3000 ppm (with a few excursions) by CO₂ injections to feed plant growth. Numerous analyses of rate of change of CO₂ concentration at many different concentrations and at many different days after planting reveals a strong dependence of fixation rates on CO₂ concentration. In the middle period of growth (days 31 – 61), fixation rates doubled for CO₂ at 450 ppm compared to 270 ppm, doubled again at 1000 ppm and increased a further 50% at 2040 ppm. High productivity from these crops and the increase of fixation rates with elevated CO₂ concentration supports the concept that enhanced CO₂ can be a useful strategy for remote life support systems.