

Does Atmospheric CO₂ Concentration Affect the Productivity of Agricultural Crops?

Carbon fixation happens in photosynthesis by three different pathways. The most common pathway is the C₃ pathway some plants use the C₄ pathway while others use the CAM pathway. The atmospheric concentration of CO₂ has been rising globally, and scientists wondered whether this would affect C₃ and C₄ plants differently. To investigate the relationship, researchers grew corn (a C₄ crop) and velvetleaf (a C₃ weed found in cornfields) plants under controlled conditions for 45 days, where all plants received the same amounts of water and light. The plants were divided into three groups, and each was exposed to a different concentration of CO₂ in the air: 350, 600, or 1,000 ppm (parts per million). The data in the table show the dry mass (in grams) of corn and velvetleaf plants grown at the three concentrations of CO₂. The dry mass values are averages of the leaves, stems, and roots of eight plants.

	350 ppm CO ₂	600 ppm CO ₂	1,000 ppm CO ₂
Average dry mass of one corn plant (g)	91	89	80
Average dry mass of one velvetleaf plant (g)	35	48	54

- [SP 3] Identify the independent and dependent variables.
 - [SP 3] Graph the data.
- [SP 4] Compare the relationship between increasing concentration of CO₂ and the dry mass of corn to that for velvetleaf.
 - [SP 6] Considering that velvetleaf is a weed invasive to cornfields, predict how increased CO₂ concentration may affect interactions between the two species.
- [SP 4] Based on the graph, estimate the percentage change in dry mass of corn and velvetleaf plants if atmospheric CO₂ concentration increased from 390 ppm (current levels) to 800 ppm. To do this:
 - Find the estimated dry mass of corn and velvetleaf plants at 390 ppm and 800 ppm.
 - To calculate the percentage change in mass for each plant, subtract the mass at 390 ppm from the mass at 800 ppm (change in mass), divide by the mass at 390 ppm (initial mass), and multiply by 100.
 - [SP 6] The researchers had hypothesized that C₃ plants would grow better under increased CO₂ concentration. Make a claim about the growth of C₃ plants and C₄ plants under increased CO₂ concentration. Justify your claim.