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Effects of drought and elevated atmospheric carbon dioxide on seed nutrition and 15N and 13C natural abundance isotopes in soybean under controlled environments

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Global climate changes due to elevated temperature and CO_2 will lead to high heat and drought in some regions, affecting crop production and seed nutrition. Limited information is available on the effects of drought and elevated CO_2 on seed nutrition (protein, oil, fatty acids, sugars, and minerals). The objective of the current research was to evaluate the effects of drought and elevated CO_2 on soybean seed nutrition in two soybean cultivars of maturity group VI.

Soybean plants were subjected to ambient (360 μmol mol^{-1} CO_2 concentration) and elevated CO2 (700 μmol mol^{-1} CO_2 concentration) and under irrigated and drought conditions. The results showed that drought or drought with elevated CO_2 resulted in high protein and oleic acid, but low oil and linoleic and linolenic acids. Significant decreases of sucrose, glucose, and fructose concentrations were noticed, but less effect on raffinose and stachyose was observed. Major elements such as N, K, Fe, B, and Zn were reduced under drought or drought with normal or elevated CO_2 concentrations. Seed δ^{15}N (^{15}N/^{14}N ratio) and δ^{13}C (^{13}C/^{12}C ratio) natural abundance isotopes were also altered under drought or drought with ambient or elevated CO_2concentrations, reflecting nitrogen and carbon metabolism. The current research demonstrated that drought alters seed nutrition. Higher oleic fatty acid and lower linolenic fatty acid are desirable traits for oil stability and shelf-life. The research further provides new knowledge on the understanding of the effects of drought and elevated CO_2 on seed nutrition, and creates opportunities for breeders to select for drought tolerant with elevated CO_2 varieties to maintain high nutritional value seeds and sustain food source and food security for humans and livestock as soybean is a major source for protein and oil for human consumption and soymeal for animals.