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Charlotte Henriet, Anderson Kilandamoko, Delphine Aime, Jonathan Kreplak, Thierry Balliau, Michel Zivy, Vanessa Vernoud, Karine Gallardo

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The interplay between sulfur nutrition and the drought response in pea: a focus on seed development and composition

C. Henriet[1], A. Kilandamoko[1], D. Aimé[1], J. Kreplak[1], T. Balliau[2], M. Zivy[2], V. Vernoud[1], K. Gallardo[1]

[1] *Agroécologie, AgroSup Dijon, INRA, Université Bourgogne Franche-Comté, Dijon, France*
[2] *INRA, CNRS, PAPPSO, UMR 0320 / UMR 8120 Génétique Végétale, Gif-sur-Yvette, France*

Pea (*Pisum sativum* L.) produces seeds rich in proteins, but seed yield and quality remain unstable due to various stresses, including drought and sulfur deficiency that interact in the context of climate change and reduced sulfur deposition. To investigate the interplay between sulfur nutrition and drought, sulfate-deprived pea plants were subjected to a short water-stress of 9 days during the early reproductive phase. While drought alone did not impact seed yield, sulfur deficiency alone or combined with drought decreased it by 38% and 65% respectively. An analysis of the seed protein composition revealed differences in the accumulation of sulfur-rich (11S) and sulfur-poor (7S) globulins in response to individual or combined stresses. While the 11S/7S globulin ratio did not vary in response to drought alone, it decreased by 88% in response to sulfur deficicency, but only by 47% under combined stress conditions. To decipher the strategy used by plants to regulate the 11S/7S ratio, the partitioning of carbon, nitrogen and sulfur between the different plant compartments was studied. Next, to pinpoint the mechanisms by which seeds adjust their metabolism under multi-stress conditions, developing seeds were collected at three time points and subjected to shotgun proteomics. A total of 2237 proteins were identified and quantified and the data were used to build a co-abundance protein network, which enabled the reconstruction of the metabolic pathways governing early seed development in pea and highlighted the impact of drought combined with sulfur deficiency on these pathways.

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