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Light changes promote distinct responses of plastid protein acetylation marks

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Protein acetylation is a key co- and post-translational modification. How different types of acetylation respond to environmental stress is still unknown. A member of the newly discovered family of plastid acetyltransferases, which is featuring both lysine- and N-terminal acetyltransferase activities, was used to obtain a holistic multi-omics acetylation-dependent view of the acclimation of plants to short-term light changes.
We investigated the role of acetylation in the plant's response to changes in light intensity using mass spectrometry-based proteomic and acetylome profiling. We grew WT and *gnat2* plants under the same conditions and subjected them to high light, darkness, or standard growth conditions for two hours. This analysis revealed that the different types of acetylations, catalysed by GNAT2 in the chloroplast, distinctively respond to changes in light conditions.

Under high light treatment, the *gnat2* mutant showed a more pronounced de-regulation in the lysine acetylome, with 50 acK sites up-regulated compared to only nine acK sites in the WT. The *gnat2* mutant specifically downregulated diverse anabolic reactions and upregulated the base excision repair pathway in response to short-term high light treatment. The analysis also showed that the gnat2 mutant had a more pronounced de-regulation in the lysine acetylome under darkness, with 7 acK sites significantly changed compared to only 2 acK sites in the WT.

Furthermore, the analysis revealed that plastid NTA yield did not significantly change under different light conditions. However, the *gnat2* mutant displayed downregulation of transcripts involved in translation-related pathways under darkness, suggesting that GNAT2 might be involved in the light-dependent control of translation.

In conclusion, our study highlights the importance of lysine acetylation in the plant's response to changes in light intensity and suggests that plastid K- and N-terminal acetylations may respond differently to environmental or developmental stimuli. Our research provides valuable insights into the role of lysine acetylation in the plant's response to changes in light intensity and the interplay between genetic and environmental factors by mass spectrometry-based acetylome profiling.

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