**Chloroplast Acetyltransferase GNAT2 Acts as a Redox-regulated Switch for State Transitions in Tomato**

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In nature, due to the variability of environmental factors, plants grow in a dynamic light environment which affects the growth and productivity of field crops. The fluctuating light breaks the balance of electron transport causes ROS overaccumulation in chloroplasts and changes the redox state of the PQ pool. It is considered as a kind of abiotic stress. State transitions are a dynamic process to balance the amount of light energy received by photosystem I (PSI) and photosystem II (PSII) to maintain an optimal photosynthetic yield and to minimize photo-damage under a fluctuating light environment. Reversible phosphorylation of the light-harvesting complex of PSII (LHCII) has been considered critical for regulating state transitions. While acetylation of photosynthetic proteins also plays an important role in state transitions but the molecular mechanisms are poorly understood. In this study, we identified a chloroplast lysine acetyltransferase, GNAT2 in *Solanum lycopersicum* and show that *gnat2* mutants are deficient in state transitions and retarded in growth under fluctuating light, and display a late-ripening fruit phenotype when grown in a greenhouse. Quantitative lysine (Lys) acetylome analysis suggests that 6Lys of mature Lhcb2 protein is the target of GNAT2 and is involved in state transitions. 131Cys-related redox changes of GNAT2 affect its acetylation activity on Lhcb2. Therefore, we propose that the chloroplast redox state may regulate the activity of GNAT2 which in turn acetylates 6Lys of Lhcb2 to switch on state transitions in higher plants when facing fluctuating light stress.