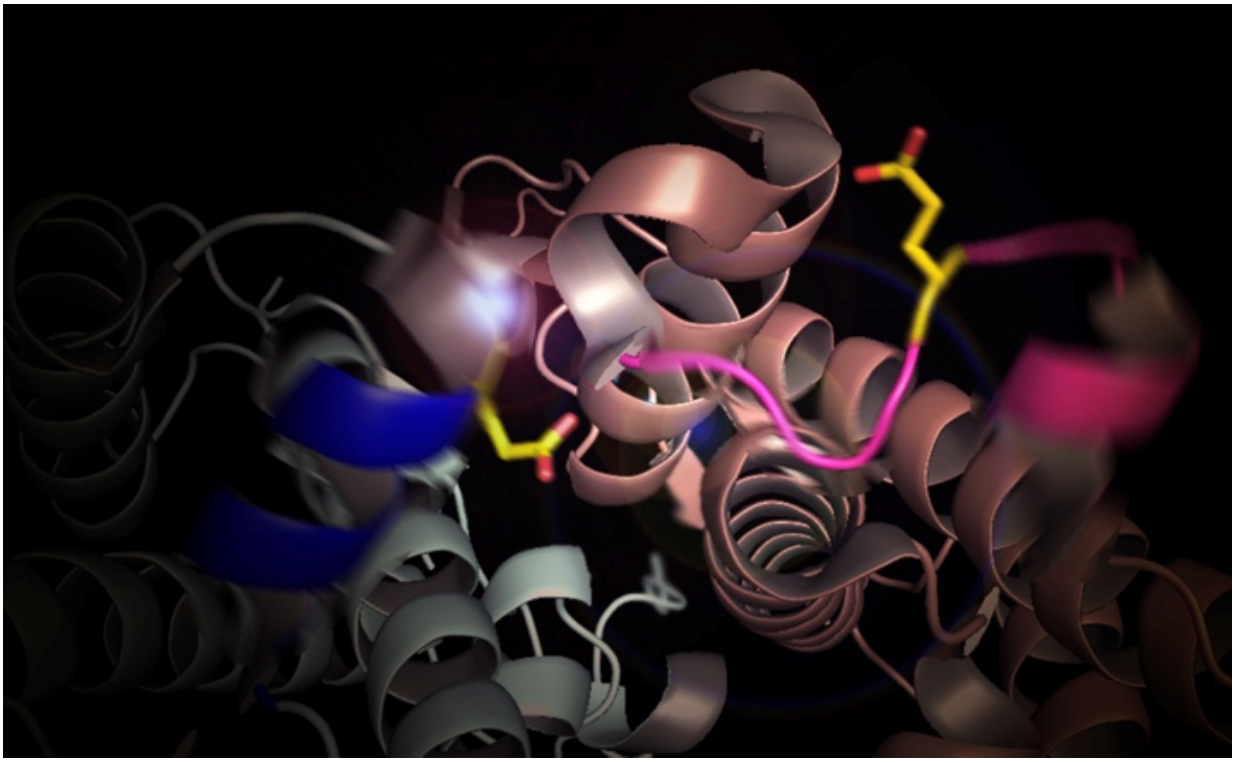
How do plants protect themselves against too much sunlight?

April 23 2021



The protein structure of PsbS, with the two glutamate side chains (yellow) that react upon acidification in excess light and in response induce a conformational change of the blue and pink protein sites. Following, this activates a protection mechanism. Credit: Leiden University

That a switching protein plays a role in protecting a plant from too much sunlight was already known, but how exactly was not yet understood.

The research group of Anjali Pandit has now discovered that this protein changes shape when there is too much sunlight. The results have been published in *Nature Communications*.

Plants need light, but in full sunlight so-called photodamage can occur: acidification takes place in the chloroplasts of the plant. The hypothesis is that the switch protein PsbS reacts to this acidification and sends a signal to the light antenna of the plant. This antenna then switches itself off and ensures that the bright sunlight shining on the plant is converted into heat, so that the plant is no longer damaged.

Discovery

Chemist Anjali Pandit, her former Ph.D. candidate Maithili Krishnan of the Leiden Institute of Chemistry and researchers of VU Amsterdam have now discovered how the switching effect of the PsbS protein works: they discovered that the protein changes its shape when there is a surplus of sunlight. To this end, they made targeted mutations on the protein. Subsequently, using advanced NMR and infrared laser techniques, they managed to show where essential structural changes take place in the protein.

Global food security

The protection mechanism in which the PsbS protein plays a crucial role is important for plants, but it also limits how efficiently a plant can convert sunlight into energy. Pandit: "That is why it is important that we learn more about the mechanisms behind photosynthesis. By tinkering with photosynthesis, for example by fine-tuning this protection mechanism against damage, we can improve crops. Think of a higher food production and a better tolerance against drought." Earlier research shows that tobacco plants with increased PsbS production yield 15

percent more biomass.

The next step is to find out how PsbS transmits a warning signal in the plant and how this leads to the adjustment of the photosynthesis reaction. For this, a team of researchers, of which Pandit is part of, will join forces with the help of a NWO ENW-GROOT grant from 2020. "With this kind of fundamental research, we hope to contribute to global food security in a changing climate."

More information: Maithili Krishnan-Schmieden et al. The molecular pH-response mechanism of the plant light-stress sensor PsbS, *Nature Communications* (2021). DOI: 10.1038/s41467-021-22530-4

Provided by Leiden University