Plants fix DNA differently from animals

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In mammalian cells, the transcription factor p53 most responsible for healthy growth of the organism. The equivalent in plants is Suppressor Of Gamma Response 1 (SOG1), a factor that does not share a common evolutionary ancestor with p53. While p53 has been exhaustively studied, much less is known about SOG1. A new study led by researchers at the Nara Institute of Science and Technology (NAIST) reports in *The Plant Journal* concerning the target genes of SOG1 and the key DNA sequence responsible for its binding to promoters. In addition, it shows SOG1 has an immune function, unlike p53.

In mammalian cells, DNA damage leads to a number of molecular events that eventually phosphorylate and activate p53. Many of the same events also phosphorylate and activate SOG1 despite the molecules being quite different, notes Professor Masaaki Umeda and Assistant Professor Naoki Takahashi, who led the study.

"SOG1 plays a crucial role in DNA damage response as p53 does in animals. Phosphorylation is necessary for the activation of both. But the amino acid sequences of SOG1 and p53 display no similarity and we do not know the target genes of SOG1," the authors write.

Umeda has been using Arabidopsis, a popular laboratory model, to study plant cell division. In the new study, his scientists showed that in Arabidopsis, SOG1 is only phosphorylated and thus activated upon DNA damage. The phosphorylated SOG1 then binds to promoters of a number of genes, many of which are responsible for DNA repair and cell division. However, while both SOG1 and p53 target DNA repair genes,

SOG1 showed a higher affinity for genes that conducted repair through homologous recombination. Additional study revealed that a specific palindromic DNA sequence in the target promoters was crucial for SOG1 binding.

"Considering that SOG1 and p53 regulate different sets of DNA repair-related genes, it is probable that plants and animals have distinct tendencies for activating DNA repair pathways," says Umeda.

Interestingly, while the majority of SOG1 target genes were involved in DNA repair and cell cycle control, a significant subset respond to pathogen invasion, which is unlike p53, but only if the pathogen was fungus and not bacteria. Why SOG1 targets genes that elicit an immune response only to fungal infection even though DNA damage occurs regardless of the pathogen is an open question that deserves further study say the researchers.

Umeda believes that understanding the SOG1 gene targets and the SOG1 immune function could allow for better farming through the modulation of DNA damage signaling.

"Environmental factors can cause DNA damage, which activates SOG1. If we are able to control this activation, we could control the growth of agricultural products," says Umeda.

More information: Nobuo Ogita et al, Identifying the target genes of SUPPRESSOR OF GAMMA RESPONSE 1, a master transcription factor controlling DNA damage response in Arabidopsis, *The Plant Journal* (2018). DOI: 10.1111/tpj.13866

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