

Key mechanism in the plant defense against fungal infections

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Arabidopsis thaliana plants inoculated with *Botrytis cinerea* spores. The two on the left correspond to wild-type plants, more resistant to infection than those on

the right, corresponding to plants deficient in protein SUMOylation. Credit: CRAG

Each year, fungal infections destroy at least 125 million tons of the world's five most important crops—rice, wheat, maize, soybeans and potatoes—a quantity that could feed 600 million people. Fungi are not only a problem in the field, but also produce large losses in the post-harvest supply chain stage. Also, it should be noted that some fungi produce mycotoxins, substances capable of causing disease and death in both humans and animals. Farmers use fungicides to treat fungal infections, but these are not always 100 percent effective and, moreover, consumers increasingly demand pesticide-free products.

Like humans, plants have developed defense strategies to protect themselves against pathogens. Now, a team from the Centre for Research in Agricultural Genomics (CRAG) in Spain has found that the regulation of [protein](#) activity in plants via SUMOylation is crucial for plant resistance to fungal infections.

The study, which has just been published in *Molecular Plant*, is the result of a collaboration between two CSIC researchers at CRAG: Maria Lois, expert in protein regulation, and María Coca, expert in plant immune responses to pathogen infection. Maria Lois says, "The results of this research will be used to develop new strategies for crop protection against fungal infection."

SUMOylation: Difficult to study

SUMO protein binding to other cellular proteins (SUMOylation) is a key process for many cellular functions. For example, in animals, some cancers and neurodegenerative diseases are associated with defective

SUMOylation. In plants, it is known that SUMO conjugation regulates plant development and responses to environmental stress.

However, until now, SUMOylation has been difficult to study because its complete inhibition causes plant death at the seed stage. To overcome these limitations, Maria Lois' research group has developed a new tool to inhibit the SUMOylation only partially, so the plant can develop normally. Using [genetic engineering techniques](#), the CRAG researchers introduced a small protein fragment that partially inhibits the SUMOylation.

Plants more susceptible to fungal infections

Using this new approach, CRAG's team found that plants with compromised SUMOylation showed an increased susceptibility to necrotrophic [fungal infections](#) by *Botrytis cinerea* and *Plectosphaerella cucumerina*. "These two fungi cause plant death and feed on dead tissues. *Botrytis cinerea* is a geographically widespread fungus that infects many species of plants. It is well known for viticulturists because it produces both the noble rot and the grey rot in wine grapes, affecting wine quality. *Plectosphaerella cucumerina* is a model of study, but is also an important pathogen of vegetable crops such as melon," explains the CSIC researcher at CRAG, Maria Coca.

In addition, the researchers observed that shortly after the fungal [infection](#), protein SUMOylation was decreased in the infected plants. This observation suggested that the necrotrophic fungi reduce protein SUMOylation as a mechanism of pathogenicity. Thus, this study opens new opportunities for developing novel strategies for [crop protection](#) against pathogenic fungi, as well as for the development of more specific fungicides.

The strategy to partially inhibit SUMOylation is key in this study, but it

is believed to have further applications. "This new approach will allow us to better understand SUMOylation-regulated processes and, most importantly, it is a tool that can be easily implemented in agronomically important [plants](#), even in those with high genetic complexity, such as wheat," explains Lois. "We believe that there are still many important SUMOylation functions to discover, and we have designed a molecular tool that will be helpful in this regard," the researcher adds.

More information: Laura Castaño-Miquel et al, SUMOylation Inhibition Mediated by Disruption of SUMO E1-E2 Interactions Confers Plant Susceptibility to Necrotrophic Fungal Pathogens, *Molecular Plant* (2017). [DOI: 10.1016/j.molp.2017.01.007](https://doi.org/10.1016/j.molp.2017.01.007)

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