How plants turn into zombies

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Post-graduate student Florian Rümpler from Jena University is the lead author of the publication, which explains how phytoplasmas destroy the life cycle of plants. Credit: Jürgen Scheere/FSU

Scientists from Jena University (Germany) shed light on the molecular reasons for a bacterial plant disease: In the latest issue of the science journal *Trends in Plant Science*, the researchers explain how phytoplasmas destroy the life cycle of plants and inflict a 'zombie' existence on them.

It begins as a fairy tale which later turns into a horror story: Lusciously flowering plants, surrounded by a large number of insects. Usually, both sides profit from the encounter: Feasting on the plant juice and pollen, the insects pollinate the flowers and thus secure the survival of the plants. However, sometimes the insects – in this case a certain species of leafhoppers – can bring disaster to the plants, which they are not able to overcome.

"The insects transmit bacteria, so-called phytoplasmas, which destroy the life cycle of the plants," says Prof. Dr. Günter Theißen of Friedrich Schiller University Jena (Germany). Instead of blossoming, the afflicted specimens only form vestigial leaf structures and thus prevent sexual reproduction. "These plants become the living dead," the geneticist points out. "Eventually they only serve the spread of the bacteria." Therefore, the scientists also call these plants 'zombies'.

Prof. Theißen and his Jena team have just succeeded in making a significant contribution to understanding the molecular-biological reasons for this phenomenon. In the latest issue of the science journal *Trends in Plant Science* the researchers explain how the parasites interfere with the development of plants in such a disastrous manner and inflict a 'zombie' existence on them.

One of the main culprits is a protein called SAP54, explains the post-graduate student Florian Rümpler, the lead author of the publication. "This protein comes from the bacteria and bears a strong structural resemblance to proteins which form a regulatory complex inside the plant, which permits a normal development of the blossom." On basis of modelling studies, the Jena scientists were able to show that SAP54 imitates the structure of certain MADS-domain-proteins in the infected plants that perfectly that they connect with SAP54 instead of their own proteins. This eventually leads to the degradation of the MADS-domain-proteins, so that they can no longer fulfil their normal function within the regulatory complexes of the blossom development. "This prevents the formation of petals and flower organs," Rümpler explains.

Another unanswered question is where the similarity of the molecules comes from. "It is conceivable that both proteins trace back to a common origin," Rümpler says. "However we suspect that this is not the case." Hence, the research team of Jena University postulates in their new publication that the bacterial protein has in the course of its evolution adapted so precisely to its host.

Whether the new findings will be put into practical use one day remains to be seen. The phenomenon of the phytoplasma infestation has been known for a long time; e.g. fruit growers and allotment gardeners refer to it as 'broom growth' on apple trees, and also for winegrowers and plant breeders, phytoplasmoses occasionally lead to drops in yield. "Although, we understand the infection process better now, we are not yet able to prevent it," Theißen says. Nevertheless, he and his colleagues consider the new findings a promising basis for further fundamental research. The impact of the phytoplasma infection could for instance be useful for a better understanding of the genesis of blossoms in the course of evolution.

More information: Rümpler F et al. Did convergent protein evolution enable phytoplasmas to generate 'zombie plants'? *Trends in Plant Science*, 2015, DOI: 10.1016/j.tplants.2015.08.004

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