Plants can 'switch off' virus DNA

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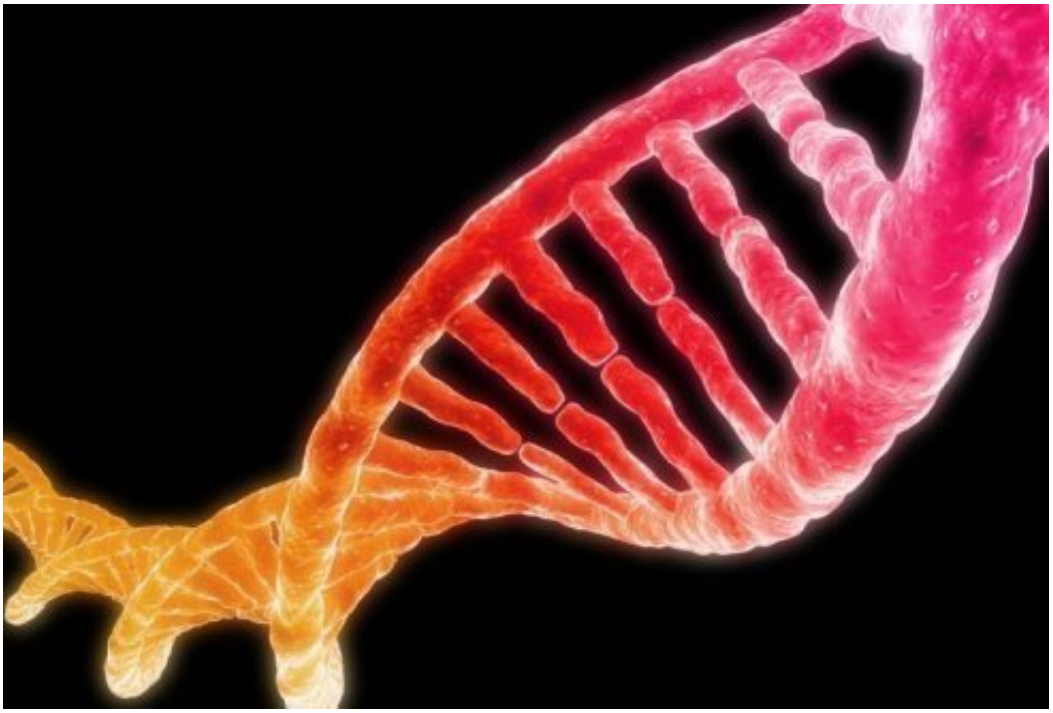

A team of virologists and plant geneticists at Wageningen UR has demonstrated that when tomato plants contain Ty-1 resistance to the important Tomato yellow leaf curl virus (TYLCV), parts of the virus DNA (the genome) become hyper-methylated, the result being that virus replication and transcription is inhibited. The team has also shown that this resistance has its Achilles heel: if a plant is simultaneously infected with another important (RNA) virus, the Cucumber mosaic virus (CMV), the resistance mechanism is compromised.

Antiviral defence via RNAi

Plant defence to viruses usually depends on RNA interference (RNAi). The genetic material of many viruses consists of RNA. A complex process in the plant causes the virus RNA to be chopped up into pieces, which means the virus can no longer multiply. In contrast to most other disease-causing plant viruses, the genetic material in TYLCV is DNA, not RNA. Therefore antiviral RNAi defence to these viruses has to happen somewhat different.

TYLCV is one of the most economically important plant viruses in the world; for this virus a number of resistance genes (Ty-1 to Ty-6) are available to commercial plant breeders. In 2013 the researchers in Wageningen succeeded in identifying and cloning the Ty-1 gene, which happened to present a member from an important class of RNAi-pathway genes. This led to a publication in *PLoS Genetics*. Their recent publication in the journal *PNAS* shows that although Ty-1 resistance depends on RNAi, instead of the genetic material being chopped up, it is being 'blocked' by methylation of the virus DNA.

No cross protection

A well-known phenomenon in the plant world is the 'immunisation' of plants by infecting them with relatively harmless viruses. The latter ensures that the defence mechanisms in plants are activated and provide 'cross protection' against more harmful, related viruses.

To their great surprise, the Wageningen researchers discovered that infection with CMV, a virus that contains RNA as genetic material and that, as a result, is not affected by the Ty-1 resistance mechanism, actually compromised resistance to the TYLCV virus. According to the researchers, this is a warning to plant breeders. The use of the Ty-1 gene

does provide resistance, but the mechanism will be at risk in plants grown in greenhouses and fields if the plants are attacked by various other types of viruses.

More information: Patrick Butterbach, Maarten G. Verlaan, Annette Dullemans, Dick Lohuis, Richard G. F. Visser, Yuling Bai, and Richard Kormelink. "Tomato yellow leaf curl virus resistance by Ty-1 involves increased cytosine methylation of viral genomes and is compromised by cucumber mosaic virus infection." *PNAS* 2014 ; published ahead of print August 18, 2014, DOI: 10.1073/pnas.1400894111

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