Identifying plant and animal DNA switches much faster and cheaper

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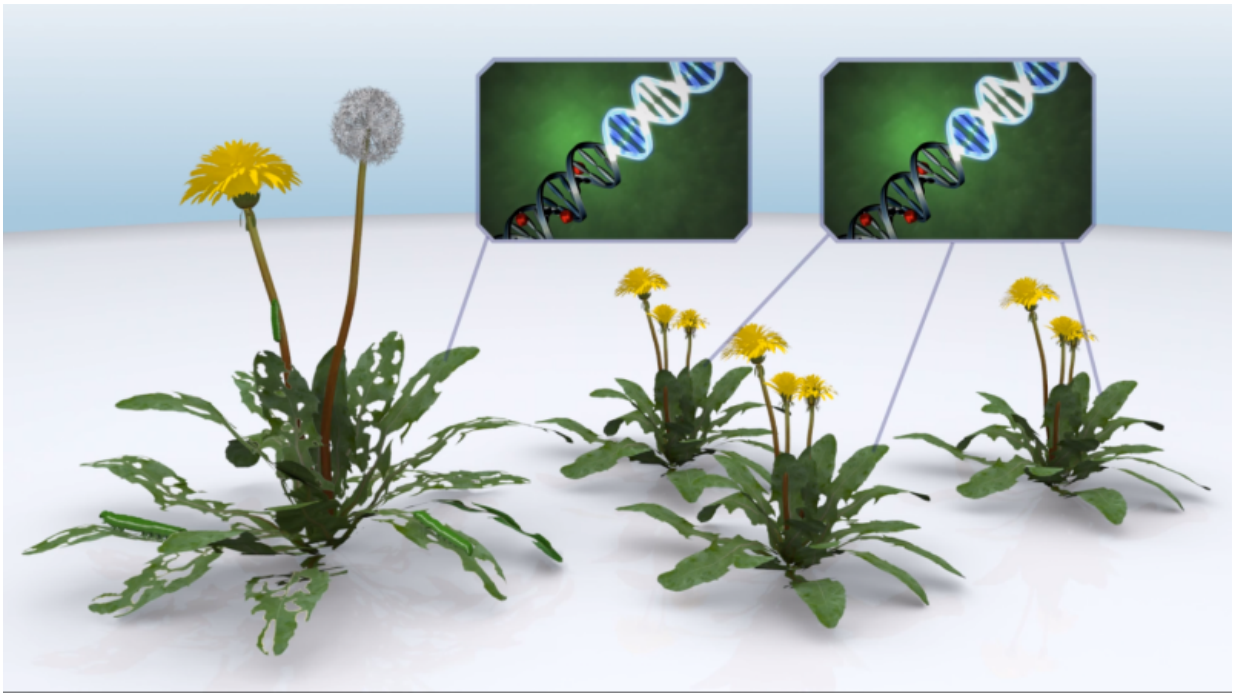

How can plants inherit valuable information from their mother that's not in the genes? Credit: Netherlands Institute of Ecology (NIOO-KNAW) / iTZiT B.V.

Epigenetics is a fast-growing field of research all over the world. Ecological epigenetics has now been further advanced thanks to the development of a new research technique. "This technique is cheaper and faster and enables research that was previously impossible to conduct." The time has come to look at how important epigenetic

changes are for dealing with climate change, plagues and other stress-factors. The research team led by the Netherlands Institute of Ecology (NIOO-KNAW) is publishing its technique in the scientific journal *Nature Methods*.

It is not found in your genes but it ís hereditary. This defines epigenetic inheritance. The prefix 'epi' means 'upon' and here it is used to mean 'on top of' the DNA. Epigenetic changes to your DNA rapidly modify the activation and deactivation of genes and may determine a great deal.

"It was simply impossible to dive in and make detailed assertions about epigenetic variations in a random plant species, without extensive prior knowledge," explains NIOO researcher and creator of the new epiGBS technique, Thomas van Gurp. The correct tools were lacking. Together with lab technician Niels Wagemaker from Radboud University Nijmegen and researchers from Wageningen University, the epiGBS method was further developed and tested. "With our new method this is now possible."

Smoking (gun)

Epigenetic research has grown immensely as a field of research all across the world. In humans, for example, it proved to be connected to the development of cancer cells and to environmental factors affecting the foetus during pregnancy. The latter includes factors such as smoking or the distress of wars. Interest in epigenetics has also recently entered the field of ecological and evolutionary research. Are rapid epigenetic changes involved in surviving plagues and climate change?

The ability to adapt is vital in terms of ecology and evolution. Genetic adaptation takes time, but epigenetic changes can occur swiftly. "This is also of interest for growers of crops," explains Van Gurp. "Will it be possible to make the next generation of plants better adapted by giving

the parent plants a specific treatment?"

How does it work?

How do you get started? First, you collect samples of dozens or even hundreds of plants. Then, you isolate the DNA. Now you apply the new method which only characterises certain pieces of the DNA for both the genes (genetic) as well as the modifications on the genes (epigenetic). Van Gurp continues to elaborate as he illustrates DNA strands with his arms, "This information can instantly reveal many things: that's that gene, that's that transposon, and this is epigenetic variation. This is a particularly useful method for (relatively) unstudied species, or what researchers call "without the reference genome of a model species"." And this can now all take place in the space of two weeks. This is particularly useful, because we only have a few model species versus an enormous biodiversity on our the planet.

Techniques for scanning for epigenetic methyl groups already exist. "But these techniques were either mostly incomplete or only possible if you already had a reference genome. The first technique left you with a great amount of guesswork while the second option was costly and time-consuming, meaning that it was never an option for normal species," explains senior researcher Koen Verhoeven. "We have now solved both of these problems." The researchers achieved this by a smart combination of DNA techniques and powerful bioinformatics, which put the pieces of information in the right place. "Starting with nothing, you are creating a genetic and epigenetic map for some thousands of pieces of DNA from the species you want."

This also immediately solves another significant issue: the differences in research results that at times show up between the model species such as Arabidopsis, about which we know everything, and other species. "Is this the result of the differences between species or due to the utilisation of

different techniques? That's fatal for research!" From now on, comparison is finally possible.

Verhoeven continues, "This new technique has greatly furthered the field of ecological epigenetics."

More information: Thomas P van Gurp et al. epiGBS: reference-free reduced representation bisulfite sequencing, *Nature Methods* (2016). DOI: 10.1038/nmeth.3763

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