Discovery holds promise for gene therapy and agriculture

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A fundamental question pursued by plant scientists worldwide for the past decade has been answered by researchers led by the University of Sydney.

"Our findings have major implications for our understanding of how plants adapt to the environment. What's more, they indicate that similar processes occur in humans so the findings should be embraced by medical researchers and agricultural scientists alike," said Dr Rodrigo Reis, lead author of the findings published this month in *Nature Plants*.

Dr Reis is from the Faculty of Agriculture and Environment at the University of Sydney.

"Our research provides crucial insights into how we might improve the environmental adaptation of plants, including the yields of crop species. It also has the potential to advance gene therapies that are being researched to address ageing and diseases, including cancer."

Although our different cells and organs have exactly the same set of genes, the ability of any organism to turn certain genes on or off within each cell is central to the functioning of the organism. It defines the identity of cells, tissues and organs, and controls responses to the environment.

An important way in which this process is regulated is by tiny RNA molecules, called 'microRNAs'. Specific microRNAs control specific

genes or sets of genes.

"You could describe microRNAs as 'master controls'. They have the capacity to switch specific genes on and off, determining whether the proteins that these genes code for are present or not. We call this the control of gene expression," said Dr Reis.

"It's clear that the loss of microRNA control of certain genes can result in cancer and a range of other pathologies".

"The tricky bit in gene expression control is that sometimes the messenger RNA (mRNA) that code for specific proteins, have to be thoroughly cleared from the cells when their task is completed. In contrast, other cells might need to keep them handy so that they can be accessed quickly if needed, for example if cells are damaged by intense sunlight."

The researchers discovered that the microRNA mechanism that controls whether a particular cell destroys or simply represses the mRNA molecules in plants relies on 'switcher' genes.

"The presence of these genes 'switches on' one of the two options, destruction or repression. If certain cells produce one switcher (DRB2) then that keeps the gene products in reserve, ready to use in an emergency. If DRB2 is not present but another one, DRB1, then the gene products are destroyed," said Dr Reis.

"Because the basic microRNA system is present in both plants and animals, similar switchers are likely to exist in humans. Based on our findings, we've indicated their likely identities in the article."

Now that the researchers have found the switchers, it will be possible to manipulate them. Regulating the switcher mechanism should allow them

to boost the capacity for environmental adaptation without interfering with development. This has clear applications for plants affected by climate change.

"The discovery and manipulation of switchers in humans could also make gene therapy more specific, with fewer side effects."

The researchers worked collaboratively for three years analysing the plant model Arabidopsis to reveal the underlying mechanism.

Provided by University of Sydney