How plants learned to respond to changing environments

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A team of John Innes centre scientists lead by Professor Nick Harberd have discovered how plants evolved the ability to adapt to changes in climate and environment. Plants adapt their growth, including key steps in their life cycle such as germination and flowering, to take advantage of environmental conditions.

They can also repress growth when their environment is not favourable. This involves many complex signalling pathways which are integrated by the plant growth hormone gibberellin.

Publishing in the journal *Current Biology*, the researchers looked at how plants evolved this ability by looking at the genes involved in the gibberellin signalling pathway in a wide range of plants. They discovered that it was not until the flowering plants evolved 300 million years ago that plants gained the ability to repress growth in response to environmental cues.

All land plants evolved from an aquatic ancestor, and it was after colonisation of the land that the gibberellin mechanism evolved. The earliest land plants to evolve were the bryophyte group, which includes liverworts, hornworts and ancestral mosses, many of which still exist today. The ancestral mosses have their own copies of the genes, but the proteins they make do not interact with each other and can’t repress growth. However, the moss proteins work the same as their more recently evolved counterparts when transferred into modern flowering plants.

The lycophyte group, which evolved 400 million years ago, were the first plants to evolve vascular tissues - specialized tissues for transporting water and nutrients through the plant. This group of plants also have the genes involved in the gibberellin signalling mechanism, and the products of their genes are able to interact with each other, and the hormone gibberellin. However this still does not result in growth repression. Not until the evolution of the gymnosperms (flowering plants) 300 million years ago are these interacting proteins able to repress growth. This group of plants became the most dominant, and make up the majority of plant species we see today.

Evolution of this growth control mechanism appears to have happened in a series of steps, which this study is able to associate with major stages in the evolution of today's flowering plants. It also involves two types of evolutionary change. As well as structural changes that allow the proteins to interact, flowering plants have also changed the range of genes that are turned on and off in response to these proteins. This work was supported by the Biotechnology and Biological Sciences Research Council.

Source: Norwich BioScience Institutes