Scientists present first model of how buds grow into leaves

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These are lead buds on a branch. Credit: John Innes Centre

Leaves come in all shapes and sizes. Scientists have discovered simple rules that control leaf shape during growth. Using this 'recipe', they have developed the first computer model able to accurately emulate leaf growth from a bud.

"A bud does not grow in all directions at the same rate," said lead author Samantha Fox from the John Innes Centre on Norwich Research Park.

"Otherwise leaves would be domed like a bud, not flat with a pointed tip."

By creating a computer model to grow a virtual leaf, the BBSRC-funded scientists managed to discover simple rules of leaf growth.

Similar to the way a compass works, plant cells have an inbuilt orientation system. Instead of a magnetic field, the cells have molecular signals to guide the axis on which they grow. As plant tissues deform during growth, the orientation and axis changes.

These are budding leaves. Credit: John Innes Centre

A leaf's the molecular signals become patterned from an early stage within the bud, helping the leaf shape to emerge.

The researchers filmed a growing *Arabidopsis* leaf, a relative of oil seed rape, to help create a model which could simulate the growing process. They were able to film individual cells and track them as the plant grew.

It was also important to unpick the workings behind the visual changes and to test them in normal and mutant plants.

"The model is not just based on drawings of leaf shape at different stages," said corresponding author Professor Enrico Coen.

"To accurately recreate dynamic growth from bud to leaf, we had to establish the mathematical rules governing how leaf shapes are formed."

With this knowledge programmed into the model, developed in collaboration with Professor Andrew Bangham's team at the University of East Anglia, it can run independently to build a virtual but realistic leaf.

The model could now be used to help identify the genes that control leaf shape and whether different genes are behind different shapes.

"This simple model could account for the basic development and growth of all leaf shapes," said Fox.

"The more we understand about how plants grow, the better we can prepare for our future - providing food, fuel and preserving diversity."

More information: 'Generation of Leaf Shape through Early Patterns of Growth and Tissue Polarity' will appear in the March 2, 2012 issue of the journal *Science*.

Provided by Norwich BioScience Institutes

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