UC San Diego Biologists Unravel How Plants Synthesize Their Growth Hormone

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Biologists at the University of California, San Diego have succeeded in unraveling, for the first time, the complete chain of biochemical reactions that controls the synthesis of auxin, the hormone that regulates nearly all aspects of plant growth and development.

Their discovery, detailed in a paper in this week's online edition of the *Proceedings of the National Academy of Sciences,* will allow agricultural scientists to develop new ways to enhance or manipulate auxin production to improve the growth and yield of crops and other plants.

More than a century ago, Charles Darwin noticed that plants produced a substance that made them bend toward light, a hormone called auxin that biologists have since found to be essential not only in regulating plant growth but also in patterning their development.

In 2006, a team of San Diego researchers headed by Yunde Zhao, an associate professor of biology at UC San Diego, discovered a family of 11 genes involved in the synthesis of auxin. Building on that work, Zhao and his colleagues at UCSD, the Salk Institute for Biological Studies and RIKEN, Japan's natural sciences research institute, have now unraveled the main biochemical pathway leading to the synthesis of auxin.

"How plants synthesize this important hormone had remained a mystery for almost a century," said Zhao. "Several genes had been known to play important roles in auxin biosynthesis in plants, but the information was fragmented and no complete auxin biosynthesis pathways in plants were identified.'

In their study, Zhao and his colleagues used sophisticated genetic approaches in combination with analytical biochemistry to identify a simple two-step chain of biochemical reactions in the genetic model plant *Arabidopsis* that converts tryptophan to indole-3-acetic acid, the main auxin hormone synthesized in plants.

"The main reason that auxin biosynthesis mechanisms had evaded scientists is that each step in auxin biosynthesis involves many genes, making the genetic dissection of auxin biosynthesis very complicated," said Zhao. "Now that we've identified the main auxin biosynthesis pathway in plants, we will be able to regulate auxin levels in crops and other plants with temporal and spatial precision, providing useful tools for agricultural biotechnology."

"Auxin affects virtually every aspect of plant growth, including most traits that are important for agriculture," said Mark Estelle, a professor of biology at UC San Diego and one of the world's experts on auxin. "For example, auxin regulates plant stature, the number and shape of plant organs, as well as seed and fruit development."

"This discovery has many important implications," he added. "To the basic scientist, knowledge of auxin synthesis will aid in the understanding of many fundamental aspects of plant development. To the farmer, this advance will open up many new opportunities for crop improvement. This is particularly important as our society faces the daunting challenges of a growing global population and a changing climate."

Zhao's collaborators were Christina Won, Xiangling Shen, Xinhua Dai and Youfa Cheng of UC San Diego; Kiyoshi Mashiguchi, Hiroyuki Kasahara and Yuji Kamiya of RIKEN; and Zuyu Zheng and Joanne Chory of Salk. The study was supported by a grant from the National Institutes of Health.

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