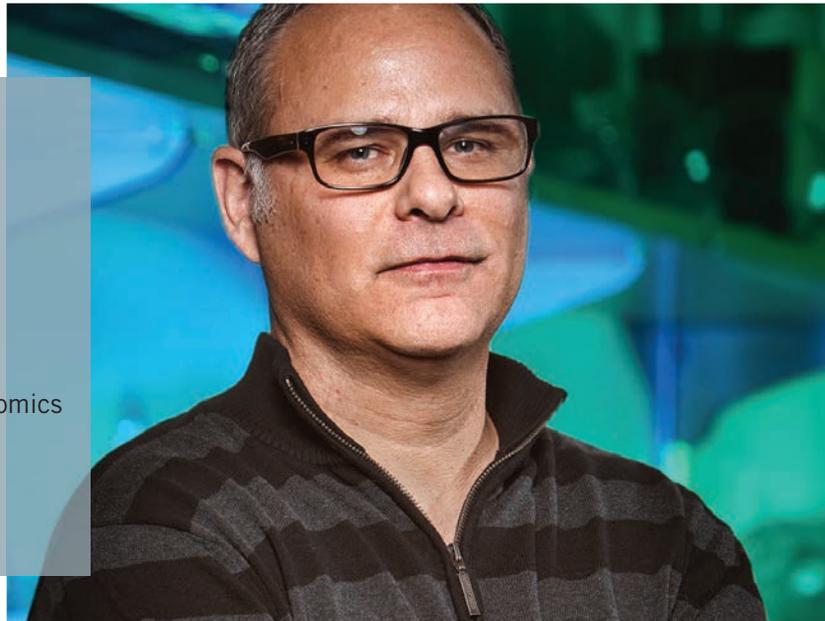


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The Problem

Plants use a remarkable diversity of capabilities to respond to their environment—they can sense light, water, chemicals and even wind flows, and in turn, speak with other plants and organisms in their environment using the language of chemistry. Over millions of years, plants evolved to harness the energy of the sun, survive in a myriad of challenging environments, absorb carbon dioxide (which most other organisms find toxic) and gather nutrients from decaying life in the soil, all while firmly planted in the ground. But farmers want to further improve how plants grow, fight off pests, generate natural medicines and produce healthy food crops. To improve plants' health and yield in globally sustainable ways, scientists first need to understand how plants have already optimized their biology through the process of evolution over nearly 500 million years.

The Approach

Joseph Noel studies the structure and chemistry of compounds produced by plants as well as how plants have evolved unique ways to make their own specialized products adapted to nearly every ecosystem on Earth. He uses biological assays to test how a plant's behavior is altered by genetic changes. He also employs chemistry techniques to replicate a plant's production pathways in the lab. The knowledge he uncovers holds clues as to how to improve plants' chemical reactions or even apply them to animal cells. For example, Noel has pieced together each step required for a plant cell to produce fatty acids. These fatty acids make up the membranes of plant cells, provide plant seeds with oils, satisfy humans with healthy fats and even offer a green and sustainable

energy source. Learning how plants produce them—and how to improve these chemical reactions—could give manufacturers a new source of natural oil.

The Innovations and Discoveries

- Using tricks he learned from plant biology and biochemistry, Noel engineered the enzyme plants use to make the anti-aging compound resveratrol, commonly found in red wine. He produced it in many other plants to arm them in their constant battle against environmental pathogens while offering potential benefits to humans as well.
- Noel was part of a group of scientists that explained how karrakins—chemicals released by plants when they are burned up—stimulate the growth of long-buried seeds to regenerate forests. The finding helps researchers understand the cycle of regrowth and renewal that happens after forest fires.
- His lab also was instrumental in the discovery of a protein, called VAS1, which coordinates different metabolic pathways in plants to make sure their parts grow at the appropriate time when light levels change. The work has paved the way to intelligently engineer a new generation of plants using completely natural genetic and biochemical programs for the benefit of humans. The findings also reveal how other organisms—including humans—coordinate all of the thousands of chemical reactions needed to survive and prosper.

For more information, please visit:
www.salk.edu/scientist/joseph-noel

Biophotonics, Cancer, Neurobiology, Neurological Disease, Stroke