

# Plants in the real world: An introduction to the JBC Reviews thematic series

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The deep relationship between plants and humans predates civilization, and our reliance on plants as sources of food, feed, fiber, fuels, and pharmaceuticals continues to increase. Understanding how plants grow and overcome challenges to their survival is critical for using these organisms to meet current and future demands for food and other plant-derived materials. This thematic review series on “plants in the real world” presents a set of eight reviews that highlight advances in understanding plant health, including the role of thiamine (vitamin B<sub>1</sub>), iron, and the plant immune system; how plants use ethylene and ubiquitin systems to control growth and development; and how new gene-editing approaches, the redesign of plant cell walls, and deciphering herbicide resistance evolution can lead to the next generation of crops.

As the world’s population grows from 7 billion to 9 billion people by 2050 (1), our reliance on plants only promises to grow. For example, the projected growth in population will require an estimated 70% increase in agricultural production, while limiting environmental impacts and adapting to changes in climate, water availability, and resource demands (1). Beyond their use as food for us and feeds for animals, the diverse biological chemistry of plants provides a vast array of building blocks for fibers, fuels, and pharmaceuticals (2–5). To keep up with the ever-increasing demands we make on plants, a better understanding of the variety of molecular, cellular, and developmental systems these organisms use to survive is critical for maintaining their productivity. In this JBC Reviews thematic series, eight reviews give a glimpse into some recent advances that help reveal how plants function in the real world.

Just like humans, plants need diverse vitamins and minerals to maintain a good diet. The first set of reviews highlight new insights on plant health and how this is important for us. Fitzpatrick and Chapman (6) focus first on thiamine (vitamin B<sub>1</sub>), a versatile molecule linked to plant disease resistance, stress tolerance, and crop yield. They particularly explore recent thiamine biofortification efforts to enhance food nutritional value and improve human health. The focus on plant micronutrients, specifically iron, continues in the review by Herlihy *et al.* (7), describing how plants use iron to support normal growth and development and for plant immune responses. They also discuss how efforts aimed at biofortification of food and feed plants for enhanced iron

content may also have positive outcomes on plant disease resistance. The review by Bentham *et al.* (8) continues the focus on the plant immune system. Global crop losses to diseases caused by pathogens and pests have multiple impacts, but new insights into the molecular machinery plants use to respond to pathogens, captured in this analysis, could be used to improve disease responses in plants.

In addition to responding to external nutrients and attackers, plants evolved internal signals that differ from microbes or animals. The first gaseous hormone identified was ethylene (not NO/nitric oxide, as many plant biologists are quick to remind their biomedical friends). The review by Binder (9) summarizes how ethylene signaling in plants operates and how they contribute to plant growth and development, as well as stress responses. Plants also use many of the canonical signaling systems found in other organisms, but plants exploit ubiquitin-based systems to an extent not found in mammals. In their review, Linden and Callis (10) highlight how critical agronomic traits—flowering, seed size, and pathogen responses—are controlled by ubiquitin systems.

An important goal of understanding basic processes in plants is to enable translational efforts aimed at improving yields, growth, and survivability. Application of gene-editing technology is at the forefront of these efforts. The review by Van Eck (11) covers current developments and challenges in plant gene editing and provides examples of how the technology can be used not just for “engineering” but also for increasing the efficiency of traditional breeding and domestication of crops (12). Plant cell wall components can be sustainable sources of a range of bio-based building blocks currently derived from petroleum. The ability to redesign and alter key metabolic processes is also being pursued for changing plant cell wall composition and structures, as reviewed by Carpita and McCann (13). The last review in the series by Gaines *et al.* (14) explores the evolution of herbicide resistance mechanisms and the impact on future crop development and field management practices.

The eight reviews in this thematic series capture only a small piece of the diverse biology and chemistry plants deploy in the real world; however, the processes highlighted here offer new opportunities for using plants to meet a variety of future challenges.

*Conflict of interest*—The author declares that he has no conflicts of interest with the contents of this article.

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