Untangling the roots of plant genomes: Supporting a 'moonshot' for botany

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Research featured this month in *Proceedings of the National Academy of Sciences* highlights the progress of plant genomics and includes a roadmap for the enormous task of sequencing the genomes of plants

worldwide.

The article, titled "Green Plant Genomes: What We Know in an Era of Rapidly Expanding Opportunities," underscores the significance of this massive endeavor.

"Nearly half a million species of plants inhabit the Earth today and the secrets to understanding nearly everything about them is hidden in the sequences of their DNA (the plant genome)," said Dr. W. John Kress, senior author of the paper and Curator Emeritus at the Smithsonian. "Plants are the foundation of environments across the planet and deciphering their genomes will be a game changer for understanding nearly all aspects of our own lives, from improving foods and medicines to inspiring artists and enhancing ecosystem stability."

The effort required to sequence plant genomes is no small task, but it is the goal of the Earth BioGenome Project, "a 'moonshot' for biology, [that] aims to sequence, catalog, and characterize the genomes of all of Earth's eukaryotic biodiversity [including plants, animals, and fungi] over a period of ten years." The article, one of ten published this week in a Special Feature in *PNAS*, is co-authored by an international group of plant scientists and outlines a map that will help researchers worldwide achieve this ambitious goal.

An organism's genome contains all the instructions necessary to carry out the processes of life and it should come as no surprise that genomes are extremely complex. Sequencing and assembling whole genomes will allow researchers to understand how species are related to and have evolved from other species; how they perform essential biological functions; and how they interact with and respond to their environments. Sequencing whole plant genomes is especially complicated compared with other groups of organisms for several reasons, but largely because there are so many species of plants and they have highly variable and

often extremely complex genomes.

Consider that as of today's date, there are just 883 whole genome sequences available for green plants compared with 2,019 whole genome sequences available for vertebrates; yet there are more than 400,000 species of green plants compared with just 73,340 species of vertebrates. The variation in genome size among plants is also astounding—some plants have a genome as small as just 65,000 individual nucleotides (the molecules that make up the four "base pairs" in the genetic code) and as large as nearly 150 billion nucleotides. There is incredible complexity involved with understanding plant genomes.

Untangling this complexity is at the root of this article. The authors present a roadmap that will help the global scientific community collect samples using new partnerships such as the Global Genome Initiative for Gardens and Global Genome Biodiversity Network as well as the latest advances in software and technology that will help researchers sequence and assemble highly complex plant genomes. With this new perspective, botanists will be able to advance plant genome sequencing like never before.

More information: W. John Kress et al, Green plant genomes: What we know in an era of rapidly expanding opportunities, *Proceedings of the National Academy of Sciences* (2022). DOI: 10.1073/pnas.2115640118

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