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PII: S0168-9452(17)31206-2
DOI: https://doi.org/10.1016/j.plantsci.2018.02.024
Reference: PSL 9768

To appear in: *Plant Science*

Received date: 15-12-2017
Revised date: 23-2-2018
Accepted date: 26-2-2018

Please cite this article as: Marta Vazquez-Vilar, Diego Orzaez, Nicola Patron, DNA assembly standards: Setting the low-level programming code for plant biotechnology, Plant Science https://doi.org/10.1016/j.plantsci.2018.02.024

DNA Assembly Standards: Setting the Low-Level Programming Code for Plant Biotechnology

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Highlights

- Low-level codes have increased our ability to program novel genetic functions into plants
- Standardization of DNA assembly methods has enabled reactions to be miniaturized and automated
- It is possible to engineer the endogenous genes of many plant species
- Synthetic biology prescribes the use of interoperable standard DNA parts
- This is driving changes in exchange of biological materials and the information held about them

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Abstract

Synthetic Biology is defined as the application of engineering principles to biology. It aims to increase the speed, ease and predictability with which desirable changes and novel traits can be conferred to living cells. The initial steps in this process aim to simplify the encoding of new instructions in DNA by establishing low-level programming languages for biology. Together with advances in the laboratory that allow multiple DNA molecules to be efficiently assembled together into a desired order in a single step, this approach has simplified the design and assembly of multigene constructs and has even facilitated the automated construction of synthetic chromosomes. These advances and technologies are now being applied to plants, for which there are a growing number of software and wetware tools for the design, construction and delivery of DNA molecules and for the engineering of endogenous genes. Here we review the efforts of the past decade that have established synthetic biology workflows and tools for plants and discuss the constraints and bottlenecks of this emerging field.

Keywords: synthetic biology; DNA assembly; molecular cloning; laboratory automation; biotechnology; genome engineering; CRISPR