Plant synthetic biology– new techniques for sustainable production of biofuels and biomaterials

Background

- Synthetic biology (synbio) is at the nexus of implementation aided by computational design of biological parts, gene circuits, and systems.
- Synbio-enabled bioproducts from more sustainable biomass have made significant progress recently.

Approach

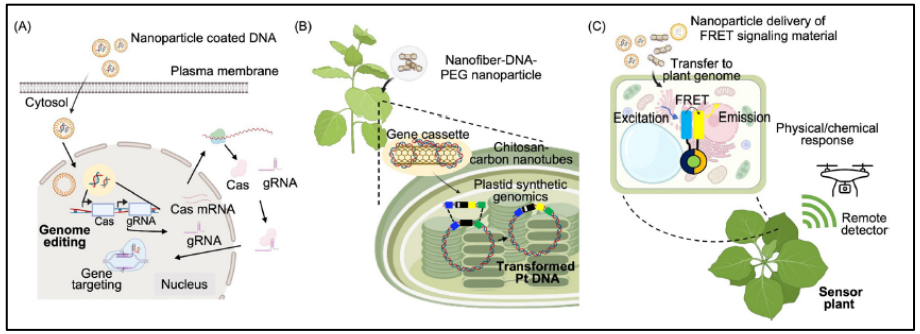
- Recent advancements and newly emerging synbio applications for sustainable bioproduction in plants were reviewed.

Results

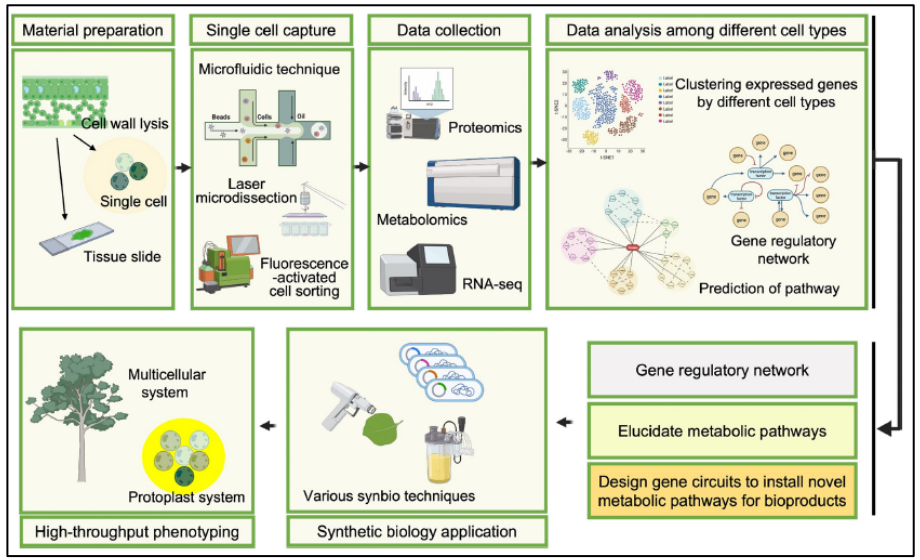
- Synbio techniques including synthetic promoter synthesis, genome editing, synthetic genomes in plastids, biosensor synthesis, and synthetic gene circuits in plants have been used for bioproduct synthesis in planta.
- Nanoparticles and nanofilament formations were considered as an effective alternative delivery system for synthetic DNA and other molecules.
- Biomass feedstock plants have been engineered by synbio techniques such as genome editing of recalcitrance-related genes and chloroplast transformation of multiple operons for biomass synthesis or photosynthesis-related metabolic pathways.
- Omics using single cell techniques has facilitated the prediction of potential genes and metabolomic pathways that will give rise to more versatile control in rationally engineered feedstock plants.

Significance

- This review highlights recent plant synbio progress and new single-cell molecular profiling towards sustainable biofuel and biomaterial production while decreasing inputs.



Nanobiotechnology for enhancing plant synthetic biology.



The workflow of application of single-cell techniques in plant synthetic biology.

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