07 PROJECT

Combination of Three Technologies Makes Plants Do More Than Just Absorb CO_2

Integrating Gene Optimization, Distant Hybridization, and Microbial Symbiosis Technologies Leads to Development of Next-Generation CO_2-Fixing Plants

Merely stopping the progression of global warming is not enough; we need to return the environment to how it was 30 or 40 years ago. The key lies in low-cost, sustainable plant biotechnologies. We are focusing on three of them: ***gene optimization, super-distant hybridized plants, and microbial symbiosis***. By combining technologies based on different principles, we aim to achieve results that cannot be reached with any single one.

Using Plants' Power in Creating a Content, Comfortable Society

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We wish to create an Earth where everyone can live comfortably throughout their lifetime. A powerful determination to do that continues to drive our research. It will require achieving not just zero emissions, but negative emissions. In other words, we need to increase the amount of carbon that is fixed in the environment. Trees that have been fine-tuned through gene optimization technology and exhibit superior CO_2 fixation can produce dense, sturdy, and flame-resistant building materials. Imagine a city of high-rises built with wood from these trees. The city would act as a forest, and as long as those buildings remain there, CO_2 stays there. It would be a city that truly symbolizes environmentalism.

Combination of Three Technologies Makes Plants Do More Than Just Absorb CO_2

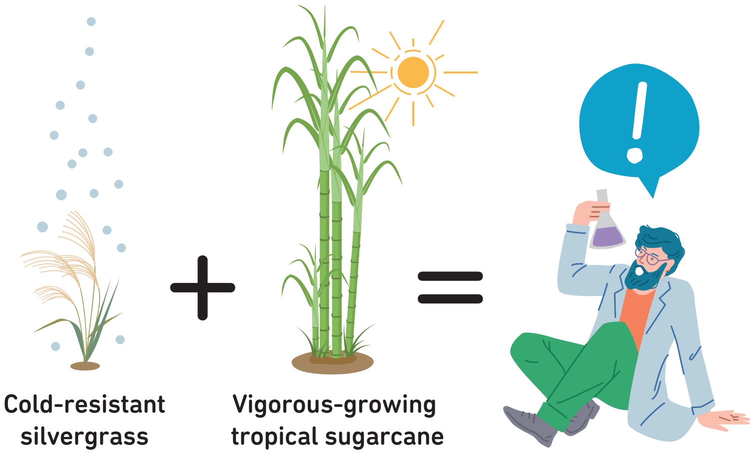
» Using Biotechnology to Create New Plants

1. Gene Optimization

This technology enhances plants' ability to capture CO_2 by forcing small changes to their genes that mimic naturally-occurring ones. Increasing the ***lignocellulose*** in tree cells in turn increases woody biomass, a reusable biological resource, and the amount of CO_2 fixed by the plants, thus helping prevent global warming. Furthermore, it results in sturdy trees with high density and strength, expanding applications as a building material.

2. Using Super-Distant Hybrids to Create New Plants

Using *in vitro* fertilization and other breeding methods, we attempt to create new species that cannot be crossbred in nature. For example, by crossing plants with different characteristics, such as one that is cold-resistant and another that grows well in tropical regions, it may be possible to create a plant that grows vigorously regardless of the location. We hope to use fast-growing grasses developed with this technology to generate biomass power and produce jet fuel to reduce petroleum consumption.



3. Microbial Symbiosis

This technology promotes plant growth via microbial activity. While we have thus far succeeded in increasing biomass 20 to 30 percent in the laboratory, it is actually not that easy to achieve this in the field. For example, the diversity of soil environments in which crops grow poses challenges to researchers. Issues to overcome include whether the technology is effective in every type of soil, how it should be applied, and how often soil should be treated with the microorganisms.

KEYWORD

Lignocellulose

Made of lignin and cellulose, this component of wood accounts for the majority of plant biomass. Biologically, it is the secondary cell wall of plants. Reinforcing the lignocellulose can increase the amount of CO_2 fixed by plants. An additional anticipated benefit in trees is wood that is denser, more durable, and more fire-resistant.

FUTURE VISION

2025 — Test Each of the Three Technologies

We will conduct tests using larch trees to verify the effectiveness of the gene optimization strategy, attempt to establish a new hybrid plant based on wheat with enhanced biomass, and continue with field tests to confirm the effectiveness of symbiotic microorganisms.

2027 — Apply the Technology More Broadly

Following the experiments with larch trees, we will apply the gene optimization strategy to Japanese cedars. We will develop a new hybrid of *Erianthus* grass that can be cultivated in various environments. For symbiotic microorganisms, we will establish methods for utilization.

2029 — Check and Prove the Synergistic Effects

We will verify the combined effect of the three technologies of microbial symbiosis, new hybrid plants, and gene optimization is greater than the sum of its parts.

Implementation | National Institute of Advanced Industrial Science and Technology (AIST), Tokyo Metropolitan University, Sumitomo Forestry Co., Ltd.

Project Introduction Video | https://www.youtube.com/watch?v=ho0_vySYuLU&list=PLZH3AKTCrVsVm3UN1x40WW_QK-cEXaoo3