No. B-3E

PJ : Agrobiotechnological Direct Air Capture Towards Carbon Circulation Society

Theme: DAC agriculture

Organization: National Agriculture and Food Research Organization (NARO), Tokyo Univ. Agr. Tech., Nagoya Univ., Univ. Tokyo, Kyoto Univ., Shinshu Univ., Univ. Shiga Pref., Saitama Univ.)
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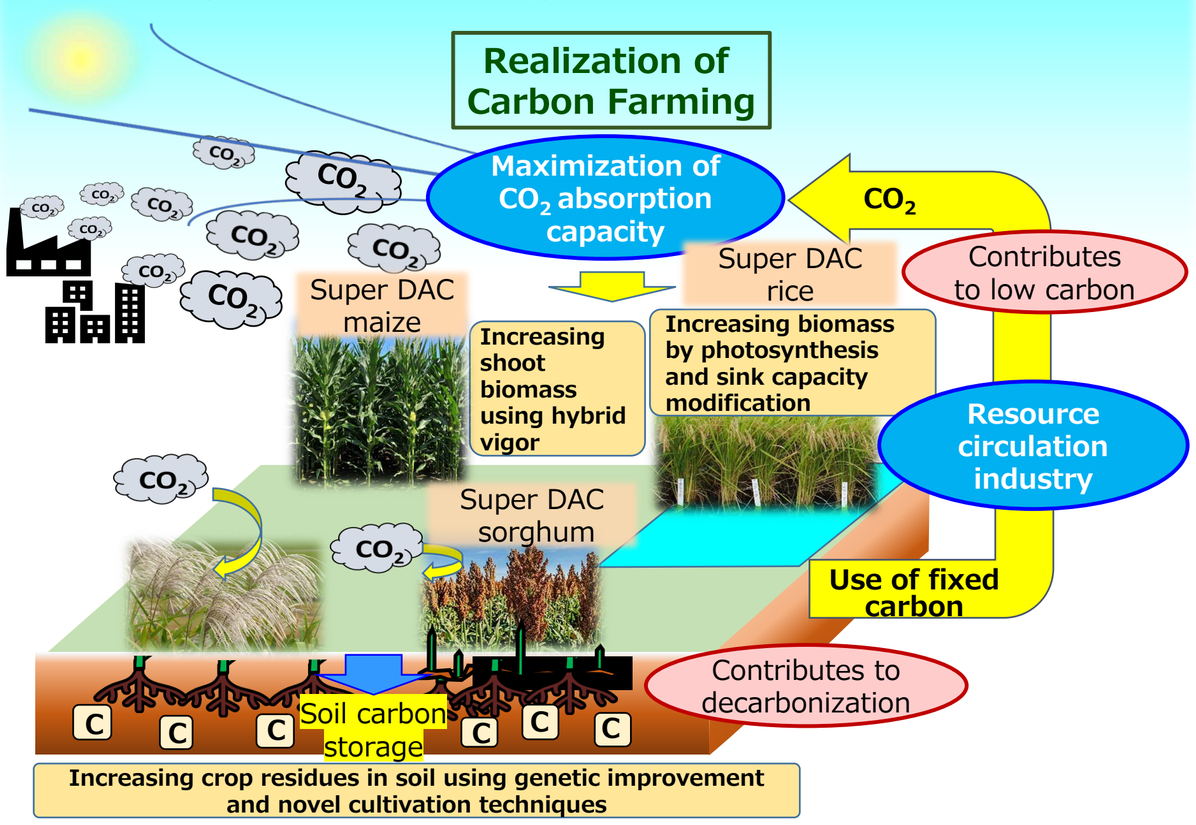
OUTLINE

Design and evaluation of “super DAC crop” by modifications and optimization of allelic combinations of genes related to CO_2 absorption/fixation and biomass production capacity. Development of techniques to assess the decomposition and carbon dynamics of crop residues in soil. Economic value and life cycle assessments of carbon circulation from crop production to recovery and utilization of valuables.

Image of DAC agriculture in 2050



Challenges, Goals, and Research theme

Technical challenges	Achievement goal (Year 2030)	Research theme
Doubling CO_2 fixation ability of crops 1	**Development of Super DAC crops** Rice grain : 50%↑ Maize shoot : 100%↑	● Theme I **Development of Super DAC Rice by increasing CO_2 absorption/ fixation ability** ● Theme II Research on **carbon fixation** by increasing crop biomass
Biomass storage in soil 2	**Increase in underground biomass and soil carbon assessment.** Sorghum root, rhizome : 100%↑	● Theme II Research on **carbon fixation** by increasing crop biomass
Circular utilization of above-ground biomass 3	**Research and analysis of breakthrough(s) in resource circulation by Super DAC crops**	● Theme Ⅲ : **Economic value and life cycle assessments** of processes for resource utilization in DAC agriculture

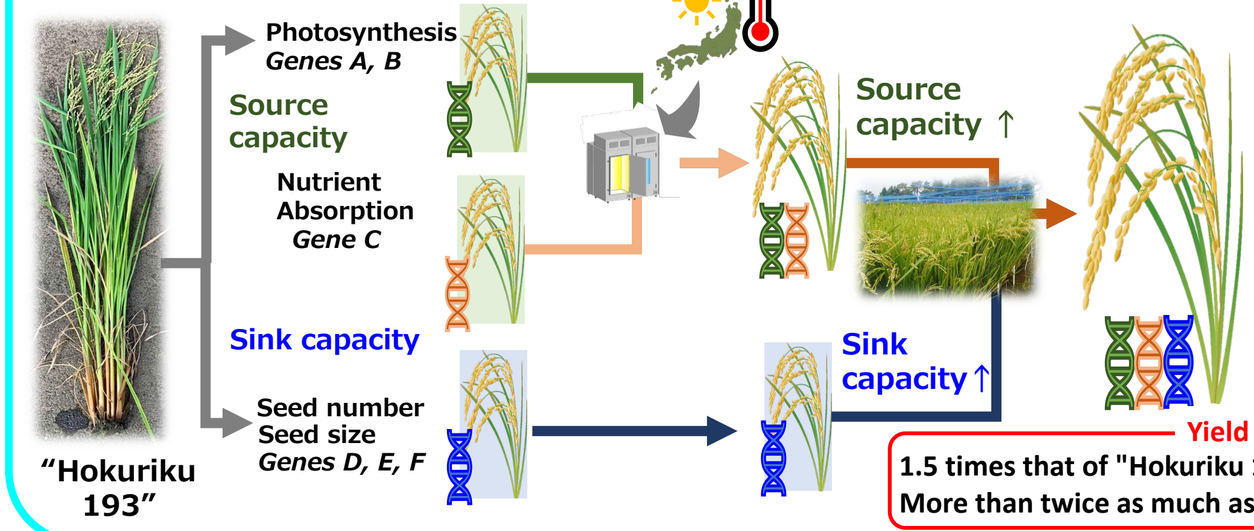
Representative institution : National Agriculture and Food Research Organization (NARO)
Participating institutions:
Theme I (Tokyo Univ. Agr. Tech., NARO, Nagoya Univ., Univ. Tokyo, Kyoto Univ.)
Theme Ⅱ (NARO, Nagoya Univ., Tokyo Univ. Agr. Tech., Shinshu Univ.)
Theme Ⅲ (NARO, Univ. Tokyo, Univ. Shiga Pref., Saitama Univ.)

Maximization of CO_2 absorption capacity

Theme Ⅰ : Development of Super DAC Rice

(Present) (2022-2024 : FS stage) (2025-2030)

- ✓ Development of breeding material by genome editing
- ✓ Evaluation under growth chamber
- ✓ Staking of genes by generation acceleration
- ✓ Evaluation under field condition



Theme Ⅱ : Development of Super DAC maize

(Present) (2022-2024 : FS stage) (2025-2030)

Mi29 *Zea Nicaraguensis*

Maize is susceptible to wet soils

A maize relative with moisture tolerance, Teosinte

Dozens of maize inbred lines

F1 hybrid between maize x teosinte

Teosinte line

Dozens of maize inbred lines

Identification of genomic regions controlling “hybrid vigor”

Shoot biomass
2 times that of maize

Evaluation of lodging resistance

Soil carbon storage

Theme Ⅱ : Increase in underground biomass and soil carbon assessment

(Present) (2022-2024 : FS stage) (2025-2030)

Sorghum

https://wric.ucdavis.edu/information/natural%20areas/wr_S/Sorghum.pdf

A sorghum relative with rhizome, johnsongrass

Collect and Select

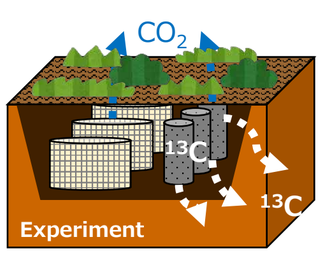
No rhizomes

Sorghum

After 2025

Hybrid between sorghum and “elite johnsongrass”

Underground biomass
2 times that of sorghum



Model estimation

Basic data for negative emission of CO_2 with Soil carbon storage

Characterization of crop traits related to increased soil carbon storage

Assessment of soil carbon storage

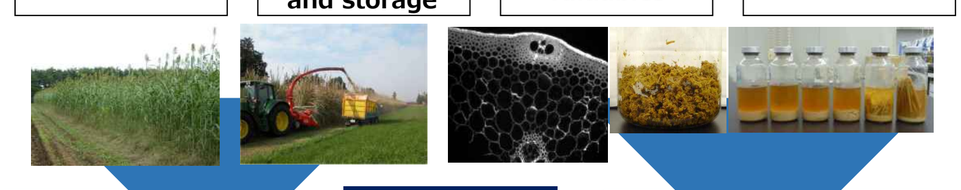
Use of fixed carbon

2022-2024 : FS stage

2025-2030

Theme Ⅲ : Economic value and life cycle assessments of processes for resource utilization in DAC agriculture

Crop cultivation → Harvest, collection, transportation, and storage → Recovery and production of valuables → Selling and consumption



Production/preparation of biomass (research and analysis)

Components, structures, and conversion efficiencies (research and analysis)

Evaluation of material characteristics and conversion properties of crop biomass
Proposal of scenarios for foundation of novel businesses by resource circulation

Demonstration of technologies for utilization of resources from Super DAC crops