Plant CO2 Sensors that Bind CO2 and Regulate Water Use Efficiency in Plants

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BACKGROUND

It is currently unknown how plants sense the level of CO2 in the atmosphere. Previously, no CO2 sensors have been identified in plants. Knowledge of how atmospheric CO2 is perceived could be used to manipulate plant CO2 responses so that the carbon and water use efficiency during plant growth could be optimized. The water use efficiency defines how well a plant can balance the loss of water through stomata with the net CO2 uptake for photosynthesis, and hence biomass accumulation.

TECHNOLOGY DESCRIPTION

UC San Diego investigators have found a new method to manipulate the exchange of water and CO2 through guard-cell stomata by controlling newly discovered CO2 sensor genes. One can thereby modify net CO2 uptake and water use efficiency in plants by modulating expression of these genes in guard cells. These findings suggest a potentially vital role for the identified genes in the sensing/signaling of CO2 in plants.

These investigators have also identified a guard cell-specific promoter that drives higher levels of expression than any other promoter in guard cells. Plant guard cells control CO2 uptake and water loss and are critically important for drought tolerance. This promoter has strength and specificity allowing effective transgene expression or silencing. Compared with other well-known guard cell promoters, this super-strong guard cell promoter is around 20 times stronger. Compared with the commonly used universal strong cauliflower mosaic virus 35S promoter, this super-strong guard cell promoter drives much higher expression of reporter genes specifically in guard cells with a minimum background expression in the surrounding cells.

APPLICATIONS

Manipulating how plants sense CO2 will aid in the production of crops with altered and improved CO2/gas exchange and water use efficiency and may also improve plant growth of different plant species at a higher atmospheric CO2 concentration. This could have commercial utility by creating plants that are useful in:

- Improving water-use efficiency for crops
- Creating drought resistant crops
- Optimizing plant growth in higher CO2 conditions
- Biomass accumulation/biofuel production

The plants with mutated CO2 sensor genes show a stomatal response as measured by real-time gas exchange analysis to changes in CO2 concentration. The proteins encoding the CO2 sensing genes can bind CO2.

INTELLECTUAL PROPERTY INFO

Patent pending, worldwide rights available.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,378,021	08/13/2019	2007-209
United States Of America	Issued Patent	9,505,811	11/29/2016	2007-209
United States Of America	Issued Patent	8,916,745	12/23/2014	2007-209

CONTACT

University of California, San Diego
Office of Innovation and Commercialization
innovation@ucsd.edu
tel: 858.534.5815.

OTHER INFORMATION

KEYWORDS

carbon dioxide, CO2 sensors, plants, biofuels, alternative energy, global warming, promoter, guard cells

CATEGORIZED AS

- **Agriculture & Animal Science**
  - Plant Traits
- **Biotechnology**
  - Food
- **Energy**
  - Bioenergy
- **Environment**
  - Other

RELATED CASES

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University of California, San Diego
Office of Innovation and Commercialization
9500 Gilman Drive, MC 0910, ,
La Jolla,CA 92093-0910

Tel: 858.534.5815
innovation@ucsd.edu
https://innovation.ucsd.edu
Fax: 858.534.7345