

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

Tech ID: 19339 / UC Case 2007-209-0

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

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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

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