

# Rice for a changing climate

Plants have evolved different types of photosynthesis suited for different environments. The main types are called C3 and C4. Major crops such as wheat and rice use the C3 pathway, while corn uses the much more efficient C4 pathway. Scientists are trying to genetically engineer rice plants that would use the C4 pathway to dramatically boost crop yields in a warming world.

## C4 PLANTS: WHAT ARE THE ADVANTAGES?



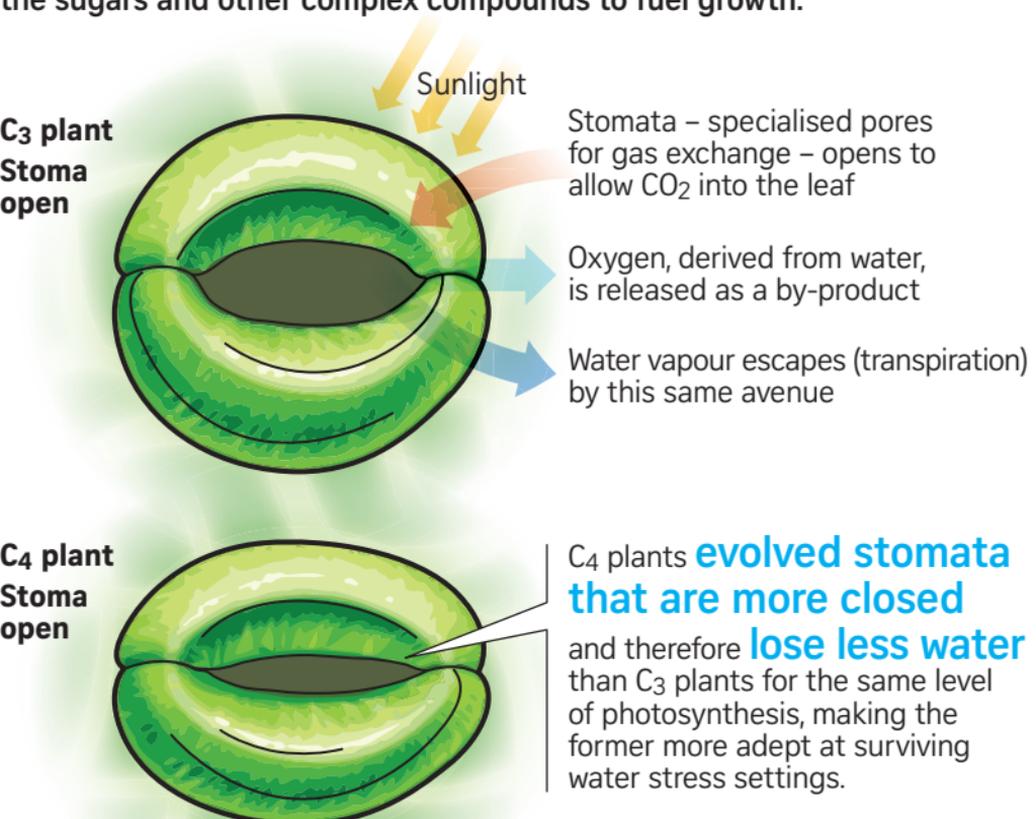
-  Are higher yielding
-  Use less water
-  Can withstand lower rainfall and higher temperatures
-  Take up greater amounts of carbon dioxide (CO<sub>2</sub>) from the air during photosynthesis
-  Use a system that "turbo-charges" CO<sub>2</sub> uptake, greatly speeding up the process of producing sugars inside the leaves

Examples of C<sub>4</sub> food crops: maize, sorghum and sugar cane

## BENEFITS OF C4 PHOTOSYNTHESIS

### 1 C4 plants can keep their stomata shut for longer periods of time and thus reduce water loss

During photosynthesis, plants use sunlight, CO<sub>2</sub> and water to produce the sugars and other complex compounds to fuel growth.



**C<sub>3</sub> plant**  
Stoma open

Sunlight

Stomata – specialised pores for gas exchange – opens to allow CO<sub>2</sub> into the leaf

Oxygen, derived from water, is released as a by-product

Water vapour escapes (transpiration) by this same avenue

**C<sub>4</sub> plant**  
Stoma open

C<sub>4</sub> plants **evolved stomata that are more closed** and therefore **lose less water** than C<sub>3</sub> plants for the same level of photosynthesis, making the former more adept at surviving water stress settings.

### 2 C4 system does not undergo photorespiration, a process that runs counter to photosynthesis

Under conditions of **hot weather, limited water** and **high light intensity**

Plant stomata close to minimise water loss, causing CO<sub>2</sub> concentrations inside the plant's leaves to fall



**C<sub>3</sub>**  
Photorespiration, a process involving wasteful uptake of oxygen and release of carbon dioxide, kicks in. As a result, the plant's **photosynthetic efficiency drops**

**Result: Crop yield is diminished**

**C<sub>4</sub>**  
Contrarily, C<sub>4</sub> plants' specially evolved mechanism of carbon fixation **suppresses photorespiration**

**Result: Crop yield is not sacrificed**

