



AS SEEN IN

CANNABIS GROWER'S HANDBOOK

Ed Rosenthal

Dr. Robert Flannery and Angela Bacca

Supplementing CO₂

Mendocino Grasslands ran a trial of outdoor CO₂ supplementation in its tunnel greenhouses. AG Gas systems were installed in three greenhouses. As a control, three additional greenhouses with no CO₂ supplementation were set to the same conditions with the same cultivars.

This technology was tested and validated at the Center of Irrigation Technology in conjunction with California State University at Fresno and the University of California at Davis. The technology was used to determine if CO₂ injection could improve yields for outdoor, field-grown tomatoes. The data from this experiment showed a 120% increase in the yield of tomatoes (Goorahoo, Cassel, and Carstensen 2003).

Mendocino Grasslands reported yield increases of 27 to 52%, with some seasonal variance in the greenhouses that were supplemented. The lowest increase was reported for a cooler season crop, while the highest yield increase was reported for a warm season crop.



Photo: AgGas

After two seasons it was decided they had used a control crop long enough and added CO₂ enrichment to all the greenhouses. Since then, the gas has been added to an open field.

The gas is delivered to the plants the same way in both the greenhouses and the open field. Pressure-compensating drip tubing with microholes facing down is held in place about 15 inches (38 cm) above the plants. The height of its support poles



The Carbocation black box control unit adjusts gas flow in real-time to deliver optimum results based on extant field conditions. The unique configuration allows for prescriptive delivery of CO₂ gas to the plants. Photo: AgGas

from the nursery stage until harvest, although CO₂ enrichment in the last 10 days is not that crucial, since plant growth has slowed.

At the farm it is stored in a rented 14-ton (13 metric tons) vacuum-jacketed tank, which keeps the gas cool without refrigeration. A tank this size provides enough gas for most of the summer. It is resupplied by the local gas company, which delivers it.

In general the best time for the plants to experience the gas release is during the brightest time of the day, under clear skies, between 10:30 a.m. and 4:30 p.m. This unit uses sensors to control the release of gas by time, light, vapor pressure deficit (VPD), temperature,

is adjustable, so it is raised as the plants grow.

CO₂ is used by plants only when there is enough light for photosynthesis. The system controls when the gas is released, and its flow rate from the tank is controlled by a software algorithm with sensors to measure light intensity, temperature, vapor pressure deficit, wind speed, and ppm of CO₂ in real time and to make adjustments continuously.

At first there were sensors in each greenhouse, but their reports were averaged so that all greenhouses received the same amount of gas. This was changed, so now each greenhouse gets individualized treatment.

Based on environmental conditions, the algorithm figures the correct CO₂ and ppm, and sensors measure and adjust it much like a thermostat. The algorithms controlling greenhouse and open field differ a bit in their calculations. The gas is used

humidity, wind, and desired ppm.

In spaces where swamp coolers are used, there is a ventilated flow of air, but CO₂ still makes sense because it increases yield so much.

In greenhouses ventilated using roof vents or reticulated roofs, the application of CO₂ will not be greatly affected for three reasons: CO₂ is being directed into a downward flow, toward the canopy; CO₂ is heavier than air so it naturally sinks; and CO₂ is being released from a tank where it is compressed. As it leaves the container, the CO₂ decompresses and cools. With horizontal air circulation in the greenhouse, the CO₂ will stay at plant level until it is used or vacated by fans.

Not all cultivars react the same way to CO₂ enrichment. Increased CO₂ does not affect quality.

Aside from the increased yield, Chance Franck, vice president at Mendocino Grasslands, made some interesting observations after using it for three years:

- ☒ The plants have less mold and fewer insect infestations.
- ☒ The plants seem to be healthier and less prone to stress.
- ☒ The buds are denser.



Notice the CO₂ tubing placed over the canopy. Photo: AgGas