

SAFETY FIRST WHEN STIMULATING PLANT GROWTH



Despite being beneficial to the growth of salad, vegetables and fruit in a greenhouse environment, carbon dioxide is dangerous to humans at certain levels. **Stephen B. Harrison**, from sbh4, says the trick is getting the balance right, which is where calibration gas mixtures from **Coregas** can help

When growing fruits, salads and vegetables in greenhouse environments, elevated levels of carbon dioxide enhance plant growth. The growth rate and development of all plants can be improved by controlling carbon dioxide (CO₂) concentrations at levels of around 800 ppm. This is approximately twice as much as the natural concentration of CO₂ in natural ambient air. Higher CO₂ concentrations up to 2000 ppm have been used in greenhouses and hydroponics, but each incremental increase in CO₂ levels above 700 ppm has diminishing benefit to the plants. Despite these diminishing returns, some operators control the CO₂ levels at 1000 or 1200 ppm to fully exploit the potential of CO₂ addition.

At high levels, CO₂ can be toxic to humans and bugs. For humans, the short-term exposure limit is 3% and the long term 8-hour time-weighted average exposure limit is 0.5% (5000 ppm). For bugs such as white fly, exposure to a CO₂ concentration of 1% for one hour has been reported to be an effective fumigation technique.

As mentioned, optimised CO₂ levels in greenhouses raise productivity and crop yields considerably, up to 40% during the darkest time of the year. In addition, they also improve the quality of the crop. When the CO₂ level in the greenhouse is optimised, the plants will produce uniform fruit, salads and vegetables of the best quality. So CO₂ can maximise both the crop yield and the sales price for the harvest. This technique is applied to greenhouses using both hydroponic and conventional soil growing techniques.

For food producing and exporting countries, such as the Netherlands and New Zealand, the investment in these high yield processes has been intense in recent decades. TJ Croeser, sales manager at the industrial gases supplier Coregas in New Zealand comments as follows:

"Dosing of carbon dioxide to the greenhouse can be from a CO₂ generator or from a carbon dioxide supply cylinder or tank. Greenhouse CO₂ generators are often simple LPG, or propane, burners, which produce CO₂ and heat from combustion of the LPG. However, enhanced flexibility and improved dosing control can be achieved by using carbon dioxide gas, which can be supplied by Coregas in New Zealand in bulk liquid tanks, gas cylinder packs or single cylinders."

ENVIRONMENTAL REQUIREMENTS

While elevated carbon dioxide levels in the greenhouse create more productive crop plants, plants go through several growth stages during their lives and each stage has its own environmental requirements, so it is essential to use CO₂ at the right times during the growth cycle for optimum results.

For example, seedlings need different light levels and fertiliser strengths than established plants. Similarly, extra CO₂ is more beneficial during some growth stages than others. Generally, dosing of CO₂ is most essential during periods of rapid growth, but researchers have also discovered how extra CO₂ early in the life of a plant can also bring benefits months later.

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To control the CO₂ level in the greenhouse, an NDIR sensor is typically used. The target set point will generally be 800 ppm of CO₂. When the sensor detects a reduced CO₂ level in the greenhouse it will activate the CO₂ dosing system. When the required CO₂ level has been achieved, the measured value will rise and the control system will shut off the CO₂ supply.

To calibrate the CO₂ sensor, it might be possible to take it out of the greenhouse into clean pure air and run an auto calibration based on the normal CO₂ concentration in ambient air. However in professional units, where the CO₂ sensor is often fixed into the greenhouse control panel and has mains electrical power supply, this calibration in ambient air is not practical. A specialty gases calibration gas mixture cylinder containing a certified pre-mixed gas at 410 ppm of CO₂ in a balance of air or nitrogen can be presented to the NDIR CO₂ sensor to simulate an automated calibration in natural air.

Alternatively, if the sensor is capable of being calibrated at user-defined levels, a certified calibration gas mixture at 800 ppm CO₂ in a balance of nitrogen can be used to calibrate the sensor close to its measured value.

As already discussed, CO₂ can be toxic to humans at a certain level. Croeser said: "Let's put the undisputed economic benefits of CO₂ dosing to one side for a moment and get down to brass tacks... there is nothing more important in that greenhouse than the CO₂ gas detector and alarm system. Every employee relies on it for their safety. Carbon dioxide is invisible and does not have a noticeable smell, so a dangerous concentration can't be detected by humans until it's too late. That's why we offer only the best quality NATA-certified calibration gas mixtures for CO₂ gas detector sensor calibration applications."

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