Extension and Outreach

#3 MITIGATION OPTIONS IN HORTICULTURE

Many mitigation activities designed to cut greenhouse gas (GHG) emissions in horticulture businesses can have the added benefit of reducing input costs and increasing production efficiency.

Under the Carbon Farming Initiative (CFI), certain mitigation and sequestration projects can earn carbon credits if conducted according to an approved methodology. Some horticulture farms might find it difficult to set aside sufficient resources and land area required to undertake a CFI project that is economically viable based on carbon credits alone.

Fortunately, a number of abatement activities not only help cut GHG emissions, but also lower input costs on horticulture farms. As a result, these activities may be worth implementing for these other advantages that provide win-win outcomes. While these activities may not yet be covered by the CFI scheme, some methodologies may be developed in the future enabling these projects to generate additional income from the sale of carbon credits.

This factsheet focuses on the general design of some of these activities that are relatively simple to implement and may help reduce farm costs.

Fertiliser management

As described in factsheet #2 in this series, nitrous oxide (N_2O) is a major GHG emitted from horticulture. N_2O is derived from nitrogen (N) fertiliser and high emissions can be an indicator of excessive nitrogen application. If plant uptake does not match the rate of applied nitrogen, a number of processes will generate N_2O from the excess N.

Efficient fertiliser management can help to mitigate N_2O emissions in horticulture and possibly lower production costs by reducing the amount of fertiliser required while maintaining yields. Measures to consider include:

- take all N sources into account (legume, manure, waste etc) before applying further N
- consider the rate and timing of N application to best possible meet plant requirements
- avoid applications of N outside crop growing season, avoiding fallow periods if possible
- use yield maps, soil tests and monitoring of crops to guide N application rates. If necessary, consult a qualified agronomist to assist with testing and optimising your fertiliser regime
- coated or slow-release formulations may better match N release to actual crop requirements
- fertilisers formulated with urease/nitrification inhibitors can dramatically reduce the biochemical reactions that generate N_2O
- for irrigated systems, fertigation can be an efficient application solution. Fertiliser should always be in a form, such as granulates, that can be applied evenly
- if other nutrients are required, these should be applied as a balanced nutrient supply will optimise N utilisation
- incorporate or band N fertiliser as subsurface applications may minimise losses and increases N utilisation
- check and adjust application equipment to ensure accurate position and application rates
- the use of technologies such as GPS, GIS, yield/growth monitors, remote sensing, plant logging, soil tests and precision farming will improve spatial fertiliser application and efficiency
- good crop and soil management and disease control will optimise crop growth
- non-legume cover crops will utilise residual N rather than losing it to the atmosphere.

The state of the soil will also impact the level of N_2O emissions, and the following measures can help minimise N_2O emissions.

- maintaining a water-filled pore space under 40 per cent will increase nitrification but reduce N_2O loss

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- improve aeration by removing any compacted layers
- substrates high in carbon may increase microbial growth and thus N_2O emissions
- incorporate soil organic matter to reduce carbon substrate and improve oxygen and water availability
- soil alterations, such as application of gypsum or crop residue, to lower salinity and pH persistence
- ensure sufficient levels of phosphorus, potassium and zinc
- cover crops will help remove excessive nitrate
- immediately incorporation of manures and organic amendments will minimise direct N_2O emissions.

Soil carbon

Increasing the amount of carbon in soils shows potential to contribute to GHG mitigation and improve productivity. For example, biochar is a carbon-rich product created by heating biomass in a low-oxygen environment. The end result can be applied to the soil providing a method of carbon sequestration. The use of biochar in agricultural soils has shown variable results, but some research show increased yields, improved physical properties of the soil and improved water use efficiency.

More information on soil carbon can be found here:

http://www.csiro.au/Outcomes/Environment/Australian-Landscapes/soil-carbon.aspx

http://www.daff.gov.au/climatechange/australias-farming-future/climate-change-and-productivity-research/soil_carbon

Minimum tillage

Another way to increase soil carbon while saving energy is to practise minimum tillage, sometimes also called conservation tillage. The movement of the soil during tillage releases carbon into the atmosphere. If management practices are changed to limit depth and repeats of tillage, the soil is likely to retain more carbon. Besides building soil carbon, these practices can also save fuel, reduce GHG emissions and retain soil moisture. Less fuel will be needed for fewer field trips and less horsepower is needed for lower tillage depths. Incorporating stubble into the soil is also a way of increasing carbon soil by building organic matter. However, a number of factors influence carbon soil levels; some research show that the presence of nutrients is also required to avoid a decrease in soil carbon.

Energy efficiency

Energy use is often the major source of GHG emissions in intensive horticulture businesses.

There are two general types of energy emissions in horticulture businesses; direct emissions from fuel used for vehicles, generators and pumps on the farm, and indirect emissions produced off site by generating electricity consumed on the farm for refrigeration, packing facilities, irrigation pumps and other equipment.

Energy efficiency improvements can be implemented in most operations on the farm. Implementation can vary between cheap and easy, to major projects requiring new equipment and significant investment.

Cold rooms

For many horticulture farms, cold rooms and refrigerated storage areas account for a considerable proportion of energy consumption. Regular maintenance can improve efficiency, saving an average of five per cent of energy costs while reducing lifetime service costs and the risk of breakdowns. Design and orientation of the cold rooms are important and should be considered for new cold rooms or upgrades to existing ones. If the geographical orientation of an existing cold room is not optimal, additional shade can be achieved through structures or vegetation. It is important to avoid air-leaks which can be a common problem, especially around the doors. If the equipment is old and nearing the end of its life, it might also be worth considering an upgrade to newer more energy efficient models. Management practises can also help to keep the running cost of the cold rooms down; for example, keep heat sources away from the cold room, ensure that doors are kept shut, minimise traffic in and out, and minimise the temperature of produce before it is shifted to the cold room.

Irrigation efficiency

Irrigation is another large energy user for many horticultural businesses. To get the best value for the electricity used to irrigate crops, it is important to have a well-fitted and maintained system. Each farm and irrigation system has specific requirements, but a few general strategies can help develop more efficient irrigation systems and practices:

- match the pump to duty required
- decrease friction losses in distribution systems
- better match crop water requirements
- implementation of maintenance procedures.

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Lighting

Lighting can consume a considerable amount of electricity in farm businesses. Timers or sensors (light or movement) are very effective in cutting back on electricity consumption. Bulbs can often be replaced with more energy efficient models. Not all bulbs are appropriate for every area so some research and consideration might be necessary to find the ideal solution. Windows and skylights can minimise the need for artificial light but can also cause additional heat, so the placement and orientation of these should be considered thoroughly. It is also important to keep all light sources clean to ensure maximum light output.

Workshop and office

The maintenance of indoor temperatures and energy consumption of electrical items are the two biggest issues when it comes to energy consumption within the workshop and office at the farm. Orientation of buildings and windows can make a large difference when it comes to keeping a place cold or warm. Trees and bushes can provide shade and shelter cheaply and efficiently while also improving the aesthetics of the work environment. Alternatively, shade cloths and shutters can be installed. Fans are very cost-effective in keeping working conditions pleasant during the warm months. It is also important to have good insulation to prevent air movement if air-conditioners are running. Electrical appliances should always be turned off when not in use for longer periods and remember that stand-by power can also add up over time. When buying new office equipment, look for products with the best possible energy rating that will most likely save money over time.

Renewable energy

With high and rising electricity prices, some farms could benefit from producing their own electricity. Solar photovoltaic (PV) panels are the most common on-farm renewable energy source. To make a solar panel investment profitable, it is important to consider variables such as the farm's overall electricity use along with peak and off-peak demand. Commercial systems that could be suitable for a typical horticulture business range between 10 to 100kW peak power output. If the panels are likely to produce more power than used on the farm, a grid connection should be considered so excess power can be sold back to the grid. For smaller systems which are only installed to lower peak demand on the farm or to power specific items, a grid connection might not be appropriate. Solar system installers can carry out an analysis of power consumption, equipment, location and mounting options on the farm and recommend the optimal system for your business. If this is of interest, please contact Growcom for further information.

Transport

Fuels used to power vehicles and machinery on the farm also contribute to the total GHG emissions from horticulture production.

The different transport fuels have different levels of emissions. For example, emissions from the most used on-farm fuel sources:

- Diesel 2.7 kg CO_2 /pr litre consumed
- Petrol 2.3 kg CO_2 /pr litre consumed
- LPG 1.6 kg CO_2 /pr litre consumed

However, it is also important to consider the combined efficiency of both vehicle and fuel.

Increasing efficiency of vehicles, machinery generators and irrigation systems etc. can dramatically lower fuel costs as well as cut GHG emissions.

Controlled traffic farming is one option that maximises efficiency by optimising the distance travelled on the farm. Careful consideration of farm layout, roads and planning to minimise multiple trips can yield substantial gains.

For more information on controlled traffic farming, please see:

http://dpipwe.tas.gov.au/agriculture/land-management-soils/soil-management/soil-structure/controlled-traffic-farming

http://www.tia.tas.edu.au/centres/vegetables/farming-systems/farming-systems/controlled-traffic-farming

More information

The Growcom energy efficiency website provides detailed information on a range of energy efficiency measures:

http://www.growcom.com.au/land-water/energy-efficiency/

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