

Introduction

Horticultural production includes a diverse range of activities. These include production methods, heating, lighting, and fuel usage. Increasing the storage of carbon in plants and soils is an important activity, as a proportion of the mitigation potential of horticulture relates to soil carbon sequestration. Production techniques, storage and waste management are all aspects that will impact on the total carbon footprint of horticultural practice. This factsheet considers some of the activities associated with horticultural production and how they can influence the carbon status of the farm.

Management Activities

The status of the soil is critical to the carbon balance of a production system. Increasing the level of organic matter promotes micro-organisms and stabilises carbon within the soil. The spreading of animal manures, fertiliser inputs, presence of permanent grasslands and hedgerows, and livestock all influence this.

Crop rotations that include legumes will fix nitrogen to the soil and lessen the need for fertiliser inputs and associated carbon costs from production and application. There are also a number of field operations that can be assessed and optimised: These include:

- Min-till or no-till operations
- Equipment maintenance
- Farm guidance systems to reduce overlap of cultivation

Suggestions for improving the carbon balance of the farm include effective management of soil organic matter, reducing cultivation frequency and conservation tillage.

Undersowing crops with low growing legumes helps reduce weeding and protects soil both during the growing season and post-harvest. Longer term fertility leys using grasses with fibrous roots help to build and hold onto carbon in the soil while N fixing plants in the ley will reduce the need for additional fertiliser inputs.

Short term catch crops such as mustard or phacelia help to give quick protection to soil against leaching of nutrient and weeds between cash crops. Crop rotations also help with weed control – by providing different timing of disturbance and competition from smothering crops like potatoes/brassicas.

Substrates

There are two main concerns with the use of peat as a substrate in horticulture. Its extraction leads to a loss of biodiversity and an increase in carbon emissions. Extraction in the UK results in greenhouse gas emissions of at least 400,000 tonnes of carbon dioxide. Fortunately there has been a steady decrease in the use of peat over the last decade. Approximately 30% of the market is now made up of peat-free alternatives – e.g. wood-fibre and coir, which are by-products from other processes.



Coir fibre is derived from the husks of coconut. It has similar characteristics to peat in terms of air and water-holding capacity. Carbon dioxide emissions associated with its use are also much less than with peat so it

represents a viable alternative. Other supplements, such as biochar, improve the composition of soils by mineral and water retention and encourage fungal growth. Livestock manure is chiefly composed of organic material and water, with the organic material comprising anaerobic and facultative bacteria. This will decompose to methane, carbon dioxide and stable organic materials.

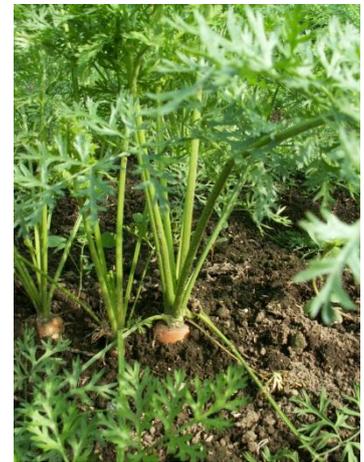
Good practice guidelines are important in order to avoid GHG emissions from manures. Nitrous oxide occurs from nitrification/denitrification processes that occur within manures. Nitrification occurs anaerobically (ammonia turns into nitrate). Denitrification is anaerobic (turns nitrate to nitrous oxide). Emission factors relating to manures include: Volatile Solids, methane producing potential, methane conversion factor, and fraction of manure in the management system. Liquid and dry manure management systems can be used, for example, farm yard manure should be well-composted, stored effectively and applied during crop growth.

The use of non-peat substrates and effective manure management are therefore critical to low carbon practices.

Protected Horticulture

In protected horticulture, heating is a crucial component. As heating and lighting are vital to glasshouse production, energy waste reduction will be essential to lowering the carbon footprint of these activities. These activities are described as energy intensive or energy extensive techniques. For example:

- Energy intensive activities include edible crops such as tomatoes or ornamental crops such as chrysanthemums. Higher temperatures are used with humidity control and CO₂ enrichment to enhance growth.
- Energy extensive activities include edible crops such as lettuce or bedding plants, where lower temperatures are used.



In enclosed environments, warm air will rise and therefore stratification can occur with warmer air higher than the crop. This inefficiency can be addressed by installing fans to circulate the air back down to crop level. Energy efficient lighting will also benefit low carbon practices. Building design, structure and maintenance are also a consideration for maximising energy savings. In the greenhouse, a number of issues are to be considered:

- Reducing air leakage from structures by ensuring that structures are well sealed
- Monitoring energy use – manual meter readings used
- Carry out maintenance and repairs – clean glass, repair broken glass and repair damaged insulation promptly
- Review greenhouse utilisation – schedule cropping such that heated areas are utilised
- Temperature measurement – check accuracy of thermometers. Temperature distribution should be optimised by using circulation fans.
- Thermal screens – these reduce heat loss from a greenhouse. Materials vary according to the greenhouse and the needs of the crop. These can be fixed or movable.
- Lighting can be important in protected crop production. Maintenance of this is vital for efficiency as light levels can decrease by up to 30% in a few years if not replaced.

Water Management

Water management and application is an important aspect of any horticultural enterprise. Harvesting rainwater is important to low carbon farming practices, with less need to pump and distribute water around the farm network, instead utilising it locally for crop production. Reducing run-off in the field will also be vital to water management, as extreme weather events from floods, can lead to soil erosion and compromise soil sequestration potential.

Organic matter levels are critical to preventing this run-off and so these levels should be maintained and enhanced for future use. Rainwater captured from buildings and roofs can be an efficient means of water management. Efficient irrigation of crops is a part of the integrated low carbon approach and measurements of soil moisture and integrated irrigation methods will be critical to this. Methods such as boom and reel, rain-guns and trickle irrigation all have different levels of irrigation efficiency and energy usage, which determine suitability to a particular application.

Storage



Storage of produce can be a major source of energy consumption within horticultural production. Store management and control, air leakage, refrigeration, insulation, air movement, temperature uniformity, have been identified as sources of energy leakage. Optimising storage equipment and conditions is therefore crucial. For bulk crop storage, air ducts leading to the store should be maintained such that there are no leaks in the ducting systems and good airflow is achieved around the crop to

promote consistent drying. The use of natural ventilation and air circulation can help reduce the carbon impact of any storage process by reducing energy usage. Efficient fans and ducting should be used.

Waste

Waste management will be a consideration as part of lower carbon horticulture, as higher waste streams lead to increased landfill. Waste plant materials should therefore be composted, or utilised where possible as animal feed to reduce GHG emissions associated with disposal. Anaerobic digestion can be used as a natural process which will produce biogas which can be used to generate heat and electricity. Anaerobic digestates are a form of biofertiliser that can provide crops with readily available nitrogen. It aids sustainability of production practices by reducing emissions of greenhouse gases associated with fertiliser manufacture.

Conclusions

- The condition and maintenance of soils is important to low carbon horticultural production
- Biological approaches to weed control are beneficial and reduce the use of inputs
- The use of non-peat substrates and effective manure management are low carbon practices
- Energy monitoring and structural maintenance is important in protected cropping practices
- Efficient and appropriate storage of produce minimises energy use and costs
- By controlling and utilising farm wastes, energy can be generated and the carbon balance of horticultural production can be greatly improved

References

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