Horticulture - Towards net zero

In 2018 approximately 18,900 hectares (ha) of vegetables and 2,100ha of soft fruit was grown in Scotland[1]. The main crops were carrots, turnips, peas, strawberries and sprouts. The contribution of horticulture to the greenhouse gas footprint of agriculture is small, primarily because of the small proportion of land use. On a per hectare basis however, horticulture has a higher impact than other agricultural sectors due to more intensive practices and higher fertiliser use. There may be a net positive impact on yield of horticultural crops in a future climate due to increases in temperature and carbon dioxide concentrations in the atmosphere. Growth will however, be limited by availability of water and nitrogen, and increased risks of extreme weather.

Emission challenges

Energy and fuel use

Heating typically accounts for 90% of the energy used in greenhouses[2]. Studies for tomato, cucumber and flowers showed that heating in greenhouses is the largest contributor of carbon dioxide emissions. Significant use of diesel in field work also contributes to carbon dioxide emissions from field grown vegetables.

Nitrogen use

Emissions from cultivation of soils and the production and application of mineral fertiliser is the largest contributor of nitrous oxide emissions from field grown products.

Water scarcity

It is likely that summers will become warmer and drier, leading to increased droughts. The majority of catchments in which horticultural production is concentrated have already been defined as being either over-licensed and/or over-abstracted. For agribusinesses operating in these catchments, retaining access to reliable supplies of water in the future will be a major priority.

Future climate impacts & extreme weather

Prolonged higher temperatures could negatively impact production through:

- More frequent droughts and heatwaves increasing the likelihood of interruption to production of long season crops.
- Insufficient winter chilling.
- Earlier flowering time may result in asynchrony with normal pollinators resulting in poor fertilisation.
- Reductions in soil moisture due to reduced summer rainfall and increased evapotranspiration will increase requirements for crop irrigation.

Loss of organic and peat soils

Areas of lowland peat are very fertile and often provide the best soils to grow horticulture crops. Drainage of carbon-rich peat soils contributes to emissions as top soil erodes. In some areas, a complete loss of peat soil could occur in 30 to 60 years.

Taking action

A 20% cut in energy costs can represent the same bottom line benefit as a 5% increase in sales[3]

> It is the practices of the farmer that play the most important role[4]

Short term solutions to reduce emissions

Given the great sophistication of fruit and vegetable production practices, there are many opportunities to reduce emissions.

Improve greenhouse energy efficiency

- Optimise temperature, humidity and radiation levels to conserve energy in greenhouses.
- Thermal screens can reduce heat loss from a greenhouse by up to 30%.
- Ensuring greenhouses are well sealed can reduce heat loss and heating costs by 25%.
- Invest in renewable energy capture (solar and wind) to avoid use of fossil fuel energy sources.

Monitor and continually review nutrient budgets to optimise nitrogen use efficiency

- Investigate use of nitrogen fixing cover crops to improve soil structure and reduce the need for fertiliser such as red clover, fetch and rye.
- Test nutrient content of organic manures before spreading to ensure optimised use of the nutrients available. Implement low emission spreading techniques and incorporate manures into soil to avoid losses of nitrous oxide. If the use of mineral nitrogen fertilisers could be reduced in relation to the yield, this would lead to savings of emissions in several steps of the production chain.

Longer term investments

Reduce water demand and retain more water:

- Upgrade to precision irrigation equipment to increase application uniformity and scheduling.
- Introduce low water use or drought tolerant varieties.
- Improve soil health to improve water retention for field grown products.
- Invest in rainwater harvesting and re-use waste water from farm buildings or build on farm storage infrastructure.

Reduce product waste

Managing the storeroom climate (humidity, temperature and oxygen content) will affect the quality and the aging of the vegetables. There is technology available for automatic climate control and for reduced oxygen levels in the storeroom. Other agri-tech innovations are being developed such as an in-field cooling system for strawberries and raspberries designed to boost quality and shelf life[5], and a fleet of autonomous multi-modal soft fruit robots to carry out a range of tasks[6].

Sequester more carbon through tree planting

Increase shading and wind shelter by planting trees in windbreaks. Protection against high winds can provide fuel savings in greenhouses of up to 10%[4].

Improving soil health

Protecting vulnerable peat and organic soils from wind and water erosion will assist in reducing emissions. Improving soil health and organic matter content of peat and mineral soils will provide multiple benefits of improved water retention, greater fertility and productivity and increased carbon storage.

Consider controlled environment farming systems

Controlled environment farming or vertical farming offers potential to increase productivity whilst using less land area. Technology advancements and investment in hydroponic, aquaponic and aeroponic systems, especially for leafy salads, microherbs and plantaceuticals (plants with medicinal values) are growing. Consider such investments carefully as set up costs and operational expenditure can be high leading to long return on investment periods.

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