9th International Strawberry Symposium: Sustainable strawberry production

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The 9th International Strawberry Symposium was held in Rimini, Italy, in May 2021, as a virtual conference, including virtual field tours, technical days and berry school. This article will focus on sustainable strawberry production presentations from the symposium.

Towards more sustainable soilless strawberry production - growing media

In Europe, there is a big move to soilless strawberry production, predominantly due to a lack of available, active soil fumigants, but also because of the advantages of faster and easier picking and other crop management processes, with the associated lower costs.

There are disadvantages from a sustainability perspective, however, as the substrate is normally only used for one season and is expensive, and costs are incurred to remove and dispose of the substrate. The smaller root volume in coir bags also means high irrigation and fertigation volumes are often used, resulting in lower resource use efficiency and pollution of watercourses with fertilisers due to run off. Peat and coir also have an environmental impact, with peat extraction having landscape degradation impacts as well as releasing sequestered carbon, and coir production having a large CO_2 footprint from transportation, as well as using large amounts of water for rinsing and buffering the raw material.

At NIAB-EMR in the UK, researchers are looking at tackling the disadvantages of soilless production by investigating four potential solutions: reuse of substrate, coir and peat free growing media, using precision irrigation and the use of biostimulants to compensate for anecdotal evidence of reduced yields when substrate is reused. Their work was presented by Matevz Papp-Rupar. Trials were performed in tabletop systems in polytunnels, initially using the June bearer (short day) variety '*Malling Centenary*', with trials ongoing using everbearer varieties (long day, day neutral). To determine if it is commercially feasible to reuse coir bags, trials were performed with virgin substrate, 1x used and 2x used substrate, under commercial fertiliser and pest and disease control in randomised trial blocks.

The addition of biochar was also tested, as growers had reported reduced yields when reusing coir. The yield, quality (class 1 fruit, BRIX) and crown rot incidence (*Phytophthora cactorum* in this case) was measured for all treatments. Results showed that there was no reduction in yield, % of Class 1 fruit or BRIX in the reused substrate, nor was there an increase in the incidence of crown rot disease. The addition of biochar to the coir bags made no measurable difference to any of the parameters measured.

Trials are ongoing with everbearing varieties. The second set of trials was to see if alternative peat and coir-free substrates are commercially viable. For these trials, mixtures of wood and plant fibre from agri/food side products and waste, along with biochar and chitin, were compared to Botanicoir® as a standard. The coir and peat-free substrates were coarser, but results showed that there was no decrease in Class 1 fruit or BRIX with these substrates, although more work is needed to ensure consistent mixes. Assessment on the effect of these substrates on disease incidence is ongoing. The use of precision irrigation was shown to save up to 25% of water and fertiliser use, without compromising yield or quality. Their work showed that optimum irrigation was at around 10% drain, with over irrigation (30-40% drain) resulting in an increase in unmarketable fruit, mainly due to softness and rots. Under irrigation (zero drain) resulted in a 10% decrease in yield.

A range of commercially available biostimulant products, e.g. Seaweeds, was tested, and results showed no positive or negative effect on the measured parameters (yield, BRIX, dry weight, fresh weight, water use efficiency, nutrient use efficiency). There are many commercially available biostimulants, but little information about their use and effectiveness, so NIAB-EMR have produced a free biostimulant database for growers to find information which can be found at https://bio4safe.eu

The take home messages from this presentation were (1) strawberry coir bags can be reused, as long as disease levels are low, (2) coir and peat free substrates can produce commercially comparable yields and quality, (3) precision irrigation can significantly improve water and fertiliser use, and (4) get more information on the efficacy of biostimulants at https://bio4safe.eu

There is a lot of interest in finding renewable and environmentally friendly alternatives for coir and peat growing media, and the potential use of growing media based on wood fibre was also presented by researchers from the Norwegian Institute of Bioeconomy Research. Their study also confirmed that wood fibre based media could be a useful alternative for hydroponic strawberry production and is responsive to precisely designed nutrient solutions to improve fruit quality. This group is conducting more detailed study of the adaptation of fertigation rates and timing for optimal performance in these substrates.

Circular use of nutrients in soilless strawberry cultivation

Bart Vandecasteele from the Flanders Research Institute for Agriculture, Fisheries and Food in Belgium presented work on the recycling of nutrients (N, P and K) in spent growing media (SGM) at the end of soilless cultivation. Recycling of nutrients is crucial to circular horticulture and environmental sustainability.

In this study they looked at the direct reuse of SGM after sanitation as well as the use of compost and biochar produced from SGM as a growing media amendment.

Upcycled SGM already contains high levels of nutrients, so the potential to minimise fertilisation during reuse of media was investigated. The nutrient availability during reuse of media, and of biochar produced from SGM was evaluated.

Similarly to the previous study, they found that SGM could be directly reused, and biochar and compost produced from SGM were also potentially useful nutrient sources in growing media. Trials were done growing ornamental crops in the spent strawberry growing media. When reusing SGM, changes in fertiliser requirements needed to be taken into account with each reuse. Available N was depleted after the first use, but sufficient P and K were still present, while K was depleted after the second reuse. The study showed that reuse of SGM and the nutrients in it may be a viable strategy for circular horticulture, and suggests that there is opportunity for 'cascading' use of SGM, firstly with direct reuse as a growing media, followed by use as feedstock for biochar or compost production to use as a growing media amendment. The reuse of SGM requires analysis of the nutrient status of the media in order to tailor fertilisation.

The same research group in Belgium is also investigating a fast screening technique for total nutrients in strawberry leaves as well as in spent growing media, using near infrared reflectance spectroscopy (NIRS) which is faster and cheaper than chemical analyses. Their work showed that this method could be used to monitor crop development and nutrient status in strawberry leaves, and is promising for analysing the nutrient levels in spent growing media, although further work is needed for validation.

Lifecycle assessment of strawberry soilless cultivation and packaging — Alessio Ilari Dept of Agricultural, Food & Environmental Sciences, Ancona, Italy

Alessio Ilari from the Department of Agricultural, Food and Environmental Sciences in Ancona, Italy, presented a study evaluating the environmental impact of strawberry cultivation and packaging, using life cycle analysis (LCA) methodology. The evaluation included cultivation and packaging steps, with cultivation under protected cropping in a soilless substrate. The analysis was done on a 'functional unit' (FU) of 1kg of packed strawberries, which has been used in other studies. The inputs included in the life cycle inventory were total yield, plants, pesticides, fertilisers, plastic film and iron (tunnel structures), growing medium, plastic film (substrate bags), water plastics (PET, HDPE, PP), paper and wood (packaging). The packaging used in the study was a 250g plastic punnet. The environmental impact evaluation measured parameters such as water consumption, global warming potential (GWP), ozone depletion (ODP), human toxicity, photochemical oxidation, acidification and eutrophication (excess nutrients and minerals in water bodies) as well as the impacts of fuel and energy consumption.

The study showed that the main contributor to environmental impacts such as global warming potential, ozone depletion and human toxicity was packaging, including pallets, plastic and cardboard. The high impact of packaging materials is common for food products, as the amount used is relatively high with respect to the amount of produce. Production of the strawberries was found to be the major contributor to acidification and eutrophication in the environment, but also had a significant impact on global warming potential and ozone depletion. In the production system used, the substrate has the most significant impact, particularly in this case where the growing media is a mix of coir and peat (which have high environmental impacts).

The global warming potential of producing 1 kg of strawberries in this system was relatively high compared with similar studies conducted in open field production, for example in the USA and Iran, but comparable to other soilless greenhouse production. Other studies have shown that N-based fertilisers and energy consumption are major environmental burdens in greenhouse strawberry production. The environmental impacts and life cycle assessment will be specific to regions and production systems.

Using LCA in this way can help with decision making on where in the production life cycle environmental impacts can be reduced in order to increase sustainability of production.

If you would like more information about any of these studies please get in touch.