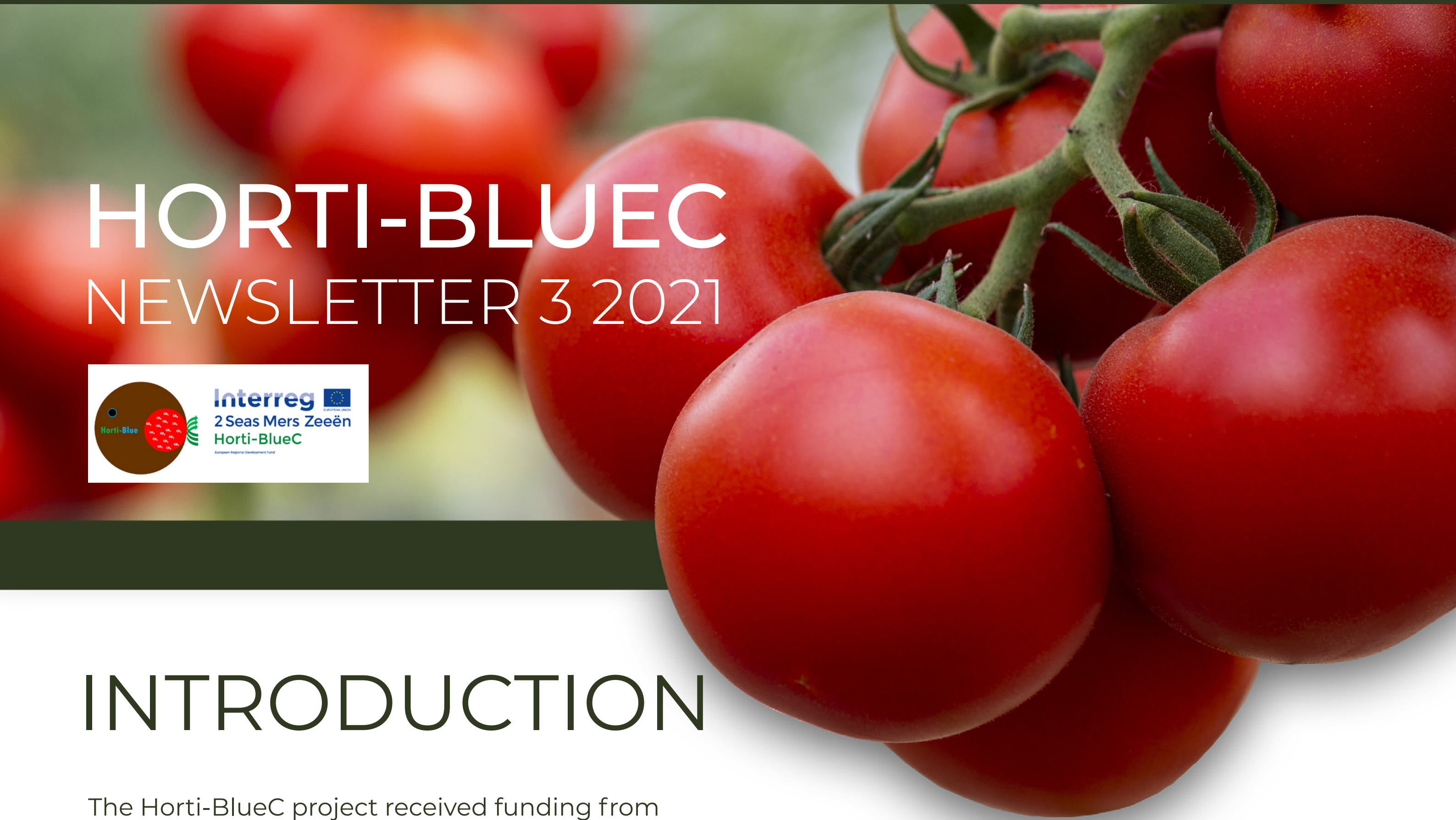


HORTI-BLUEC

NEWSLETTER 3 2021

INTRODUCTION

The Horti-BlueC project received funding from the Interreg 2 Seas programme co-funded by the European Regional Development Fund. In addition, the Province of Antwerp, Province of East-Flanders, and Province of North Holland co-fund the research. The project aims at the adoption of new circular economy solutions for greenhouse horticulture. These solutions are:

- Biochar & chitin as new additives in growing media for fertilizer replacement or increased disease suppression.
- New growing media blends: peat-free, 100% organic blends for Tomato, and peat-reduced blends (40% peat replacement) for Strawberry
- Reuse of spent growing media, i.e., both direct reuse and use as a feedstock for biochar and compost.
- New technology: Gasification for biochar, heat and energy production, and CO_2 recuperation.

Building blocks for sustainable growing media were produced out of residual materials from agriculture and fisheries; some of them could be used as bulk replacement, while others are used as amendments already effective when used in small doses. Based on this expertise, 4 valorisation chains were developed with criteria presented at three webinars to date, the 4th one will be in November:

- Large scale gasification, CO_2 reduction & biochar production: Webinar 1
- Production of chitin from shrimp shells or Chinese mitten crab: Webinar 2
- Upcycling spent growing media: direct reuse versus feedstock for biochar: Webinar 3
- Bulk replacement in growing media: Webinar 4

Based on these building blocks, sustainable growing media blends were designed and tested at pilot scale, leading to the production, and testing of considerable amounts of materials, i.e., the production of 120 L chitin and 1.600 L biochar, the reuse of 3.000 L of spent coir, and the production of 60.000 L new growing media blends, including 5.000 L compost.

The results are disseminated through 2 Open Events, 3 Newsletters, 4 webinars, more than 10 videos on the Horti-BlueC YouTube Channel, open access publications, a decision and a mapping tool, fact sheets and the online platform on our website. The links are illustrated in the following table and project partner summaries incorporate embedded links to publications. I'm grateful to all Project Partners for their highly professional work, to the Observer Partners for their support, to the Interreg 2 Seas Programme and other co-financing parties for funding the project. Please enjoy the exciting results highlighted in this newsletter, and we are happy to receive your feedback on the project results! Please email laura.golsteyn@ilvo.vlaanderen.be

Bart Vandecasteele
Horti BlueC project leader

CONTENTS

PUBLICATIONS & LINKS

Interreg 2 Seas	Project Page
Horti-BlueC	Web site platform
Horti-BlueC	YouTube channel
Decision Tool	Building Blocks for Sustainable Growing Media Blends
Mapping Tool	Shellfish contacts UK
Press Release 17.8.2021	Project News
Previous Newsletters	Newsletter 1, 2019 and Newsletter 2, 2020
Valorisation Webinar 1 (11.5.2021)	Large Scale Biochar Gasification
Valorisation Webinar 2 (20.5.2021)	Production of Chitin from Shrimp Shells
Valorisation Webinar 3 (10.6.2021)	Reuse of Spent Growing Media
Valorisation Webinar 4 (9.11.2021)	New Growing Media Blends: Strawberry and Tomato
Growing Media 2021 Symposium	International Symposium on Growing Media, Soilless Cultivation, and Compost Utilization in Horticulture

FACT SHEETS

Large Scale Biochar Gasification	Biochar Fact Sheet
Production of Chitin from Shrimp Shells	Chitin Fact Sheet
Reuse of Spent Growing Media	Reused Growing Media Fact Sheet

OPEN ACCESS ARTICLES

Peat substrate amended with chitin modulates the N-cycle...	Caroline De Tender et al., 9.7.2019
Biochar for Circular Horticulture	Fien Amery et al., 26.3.2021
Chitin in Strawberry Cultivation	Caroline De Tender et al., 3.3.2021
Chemically versus thermally processed brown shrimp shells ...	Bart Vandecasteele et al., 1.6.2021

CONTRIBUTIONS TO GROWING MEDIA 2021 OR RELATED SYMPOSIA

Microbial life in sustainable and disease suppressive growing media ...	Jane Debode et al., 2021
Nutrients in circular horticulture ...	Fien Amery et al., 2021
Circular use of nutrients in soilless strawberry cultivation ...	Bart Vandecasteele et al., 2021

NIRS as a fast screening technique for total nutrients in strawberry leaves and in spent growing media	Bart Vandecasteele et al., 2021
Extending the lifetime of coconut coir media in strawberry production through reuse ...	Lucas Shuttleworth et al., 2021
Sustainable organic growing media in a commercial tomato growing system	Julie Moelants et al., 2021
Biochar and chitin amendments for tomato substrates in commercial production ...	Ewan Gage et al., 2021

OTHER ARTICLES

Op zoek naar het verband tussen CO_2-dosering en concentratie rookgassen (ProeftuinNieuws)	Lotte Similon et al., 2020
Potentieel duurzame organische substraten in tomaat onderzocht (ProeftuinNieuws)	Lotte Similon et al., 2020
Tomatoes: Food For Health	Edward Collins et al., 2021

RESIDUAL MATERIALS AS BUILDING BLOCKS FOR SUSTAINABLE GROWING MEDIA

Biochar ECN>TNO

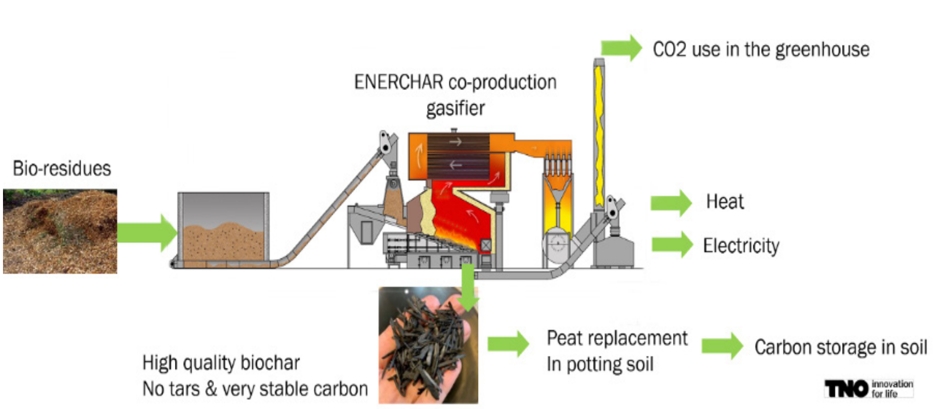
Chitin: Universite de Lille

Reuse of Spent Growing Media: NIAB EMR

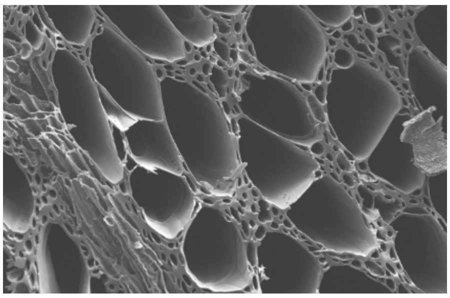
Wood fibre and green compost: AGARIS

BIOCHAR:
ECN > TNO

The main focus of TNO in the past period was the scaling up of the biochar production in order to be able to reduce the cost price of biochar. A 100-hours duration test could be performed with another technology at the TNO premises than the technology used during production of the previous batches of biochar for Horti-BlueC. This time a grate-based technology was chosen and constructed. The choice was determined by a combination of quality and a reduction in price by being able to scale up to significant size production installations (order 25 MW thermal) when becoming commercial.



The total ENERCHAR concept for the production of biochar as foreseen to enter the market soon is shown above.



The produced biochar was wetted in a cement-mixer before use in substrate mixtures and plant trials.

The first time, biochar is hydrophobic and it takes time for the water to penetrate into all the biochar pores, therefore it is wetted well in advance. After the first time of wetting, the risk for hydrophobicity of the biochar is no longer an issue.

TNO participated in the GrowingMedia2021 hybrid Symposium in Belgium in August and virtual Horti-BlueC consortium meeting in June 2021. An open access paper titled ‘Biochar for Circular Horticulture: Feedstock Related Effects in Soilless Cultivation’ was published in March.

CHITIN:
UNIVERSITÉ DE LILLE

Université de Lille

Our activity in this final year of the project was focused on the enzymatic production of chitin at a pilot scale. The enzymatic purification process involved two steps: for demineralization, shells were ground and suspended in a medium acidified with H_3PO_4 and then a deproteinisation step was achieved using a commercial enzyme: alcalase. A video demonstrating chitin production is on YouTube.

A stainless-steel hydrolysis reactor with a volume of 80 L was used. For each batch, 18 kg of ground shrimp shells were processed. From November 2020 to April 2021, 117 kg of shrimp shells from Copalis were processed and 10 kg of chitin (representing a volume of more than 100L of chitin) was produced.


Shrimp Shells


Ground shrimp shells


Shrimp shells after demineralization


Shrimp shells after demineralization and deproteinisation steps


Final product (after rinsing and drying)

NIAB EMR:
UPCYCLING REUSE OF SPENT GROWING

Trials at NIAB EMR focused on coir substrate reuse in tabletop strawberry production system. We investigated if coir bags can be directly reused and if biochar amendment at planting reduced the yield loss associated with the coir reuse. We are also testing if new, sustainable coir-free and peat-free growing media developed within the consortium could replace coir bags. We have shown that the coir reuse without yield reduction is possible for June bearer cultivar, whereas Ever bearer cultivar showed a 6% year-on-year yield decrease. New sustainable growing media blends gave comparable results to coir bags. A video summary of the work can be seen on YouTube.

We investigated if strawberries grown in reused coir bags produce comparable yield and fruit quality as in virgin coir media. We also tested if the addition of oak and beech biochar at planting affected fruit yield and quality in 2018 and 2019, which demonstrated that June bearing 'Malling centenary' cultivar could be grown in reused coir for 3 cropping cycles without significant yield and quality decline.

In 2020 we expanded the research with everbearing cultivar 'Prize' grown in virgin and 1, 2 or 3 cropping cycles old coir. We observed a small but significant negative effect of the reused coir. Yield declined year-on-year yield by about 6 % in reused coir compared to fresh coir. The addition of biochar did not have an effect on the yield of the everbearer 'Prize'.

In 2021 we are running the second season of this trial which will run till late Sept. and the results will be reported by the end of 2021. We are also investigating the microbiome in the rhizosphere, bulk coir, and biochar particles across different substrate ages to ascertain its effect on the yield decline in the reused substrate. In addition, we are also running a trial testing to see whether new innovative low-coir and low-peat substrate mixes could also be used over several seasons. We are measuring the yield parameters and powdery mildew susceptibility on the plants grown in the substrate first used in 2020 season. We presented our findings, published in Acta Hort, at the ISHS International Strawberry Symposium and the ISHS Growing Media 2021 symposium.

AGARIS

Agaris produced the substrates that were used in the final tomato and strawberry trials, conducted at Proefcentrum Hoogstraten and ADAS (see below). These experimental blends were based on sustainable and circular organic raw materials like wood fibre and green compost. By incorporating these materials, the use of peat could be limited (in case of the strawberry substrates) or even eliminated (in case of the tomato substrates). Additives such as biochar and chitin were incorporated in the mixtures to evaluate their effects on plant production and health. After production, characterization of the physical and chemical properties of the substrates was performed in our lab.

Agaris was a proud Gold Sponsor of the 2nd ISHS International Symposium on Growing Media, Soilless Cultivation, and Compost Utilization in Horticulture where the results of the Horti-BlueC growing trials were presented by the other partners. Agaris will partake in the upcoming webinar in November focusing on the valorisation of local by-products into building blocks for more sustainable tomato and strawberry growing media blends.

PROEFCENTRUM HOOGSTRATEN
STRAWBERRY TRIALS

PROEFCENTRUM
HOOGSTRATEN

In the seasons 2020-2021 the testing of the Horti-BlueC blends continued. All blends were based on a more sustainable substrate, meaning peat reduced by containing 15% compost and 25% wood fibre. Different blends were created by adding biochar or chitin in small amounts. In the first trial we focused on an increased resilience towards diseases and pests. In this trial none of the blends stimulated nor negatively influenced the immune system of the plants. In a second trial it was checked whether some of the blends could fix or release some of the nutrients. This was not the case and the use of these blends does not require a modified fertigation scheme.

In August 2020 Elsanta strawberry plants were planted in four different substrates, a control substrate next to the addition of 2g/L biochar, 2 g/L chitin or 2 g/L biochar + 1 g/L *Trichoderma* spp. In this trial we tried to record an increased resilience towards two spotted spider mite, thrips, powdery mildew, *Botrytis* and root diseases. To elevate pest/disease pressure we used two crop protection strategies, a complete chemical strategy and an IPM strategy. In the IPM strategy, we expect a higher infestation of mainly fungal diseases, so that differences are easier to observe. We monitored the number of two spotted spider mite, thrips, powdery mildew, *Botrytis* and root diseases in the different objects. After intense plant, leaf, flower and fruit evaluations we could not find an increased or decreased resilience of the crops in the biochar or chitin enriched substrates.

In the second trial we focussed on the effects of the additives in terms of nutrient use. Two g/L chitin and 10 g/L biochar were added to the sustainable substrate, to create two new test blends. These three blends were compared to a commercial peat substrate. The four substrates were combined to three different fertigation schemes to check the need of the new blends for change in fertilization. The continuous recording of gift/drain volume/ drain EC combined with a regular nutrient analysis of the gift and drain water make it possible to calculate the amounts of nutrients that were still present in the drain water. Large differences between elements in the drain water would indicate fixation or release by the added compounds in the substrate when the performance of the strawberry crop is similar.

The results of the analyses showed that substrates did not specifically release or fix certain nutrients. All substrates could maintain a healthy-looking crop and deliver production rates without any differences. Therefore, the new blends can be cultivated with the same fertilization schemes as with standard peat substrates.

Interreg 2 Seas Mers Zeeën Horti-BlueC

PROEFCENTRUM HOOGSTRATEN
TOMATO TRIALS

PROEFCENTRUM
HOOGSTRATEN

For the tomato trials at **Proefcentrum Hoogstraten** we tested the same objects in 2020 as in 2019, i.e., Mineral wool, Peat, a wool fibre blend, wood fibre blend + biochar (2g/L), wood fibre blend + biochar (4g/L), or wool fibre blend + chitin (2g/L). Moreover, there are two additional objects where we investigate the interaction with micro-organisms (wood fibre blend with *Trichoderma* spp.) and a wood fibre blend with both biochar (2g/L) + chitin (2g/L).

In this study, presented on the YouTube Channel, we did not find any significant differences in production (kg m^{-2}), fruit weight (g), amounts of fruits or plant parameters between the objects. The brix values were not affected, but the fruits were softer compared to the controls (rock wool and growbag). The EC levels of mineral wool slabs were higher compared to the plant fibre blends, especially in the beginning of the season. The alternative blends were dryer than mineral wool, mainly in winter and spring, but in summer the differences were smaller. In general, the Horti-BlueC (HBC) blends did have a lower volumetric water content than rock wool. Bark, wood fibres and coir in the blends can be responsible for a higher air capacity in the HBC blends.

In further research it would be advised to have a more specialized efficient water strategy per growing media. As no natural infections occurred during the trial, no conclusions can be drawn about the effect of the substrates on plant resilience. However, we found more Sciaridae in the alternative blends compared to the controls and it is advised to treat them with *Steinernema Feltia*. In conclusion, there were no big differences found between the standard substrates and the alternative HBC blends on plant level.

This year we are testing the most promising objects of 2020 again. As in 2019 and 2020, mineral wool is still the reference in the tomato cultivation in Belgium. Mineral wool is compared to wood fibre blend + biochar (4g/L), wood fibre blend + biochar (2g/L) + chitin (2g/L) and wood fibre blend + biochar (4g/L) + *Trichoderma spp.* (2%). This trial is still running until November 2021.

Interreg
2 Seas Mers Zeeën
Horti-BlueC

ADAS

The final trials for the Horti-BlueC Interreg research project have been carried out at our experimental station in Cambridge. Building on the outcomes from previous years' work, we have focused on exploring the relationship between chitin and biochar concentrations and crop responses to further optimize sustainable growing media development for both strawberry and tomato, including further commercial trials. The evidence base for the use of sustainable substrates in horticulture has been developed. Our activities in the final year of the project have been focused on consolidating the evidence base for sustainable substrate use in horticulture, including the optimization of biochar and chitin as substrate amendments.

In tomato, we have expanded our trials to include an additional cultivar 'Sakura' – which is more vegetatively focused than Brioso, which has been used to date. This is to test whether our innovative substrates, especially those with biochar, can promote vegetative growth at the expense of fruit production. We have also conducted a trial to explore the impact of increased biochar content alongside an expanded commercial trial to explore potential benefits of biochar in the suppression of root mat disease. Whilst full examination is not due until the end of the season, early results indicate that biochar use can have a suppressive effect on root mat disease development. This trial has also provided fruit for extensive shelf-life testing.

For strawberry, our trials have focused on further exploration of the benefits of combining the biochar and chitin in a combined treatment approach rather than in isolation. We have also cultivated strawberry plants grown on the experimental blends into a second season to test when substrate amendment can enhance the productivity over overwintered slabs.
We presented a paper at the Growing Media 2021 Horti-BlueC open event on 25th August, summarizing our results to date, and will prepare similar communications to report the outcomes of the trial at the season end.

UNIVERSITY OF PORTSMOUTH

Horti-BlueC funded PhD researcher Edward Collins, at the University of Portsmouth, is investigating the use of chitin as a growing media amendment to improve the growth and health of tomato plants. A tomato trial is currently being carried out utilising shrimp-derived chitin to improve fruit yield and antioxidant activity. Although this trial is ongoing, preliminary data indicate no negative effects to the growth of tomato plants as a result of the chitin amendments, and a suggested increase in antioxidant activity.

Horti-BlueC is investigating the use of chitin as a growing media amendment to improve crop health and yield sustainably. Edward Collins is currently conducting a greenhouse trial for tomato plants to investigate the potential effects of amending crop growing media with shrimp-derived chitin, focussing on plant growth and fruit yield and antioxidant activity.

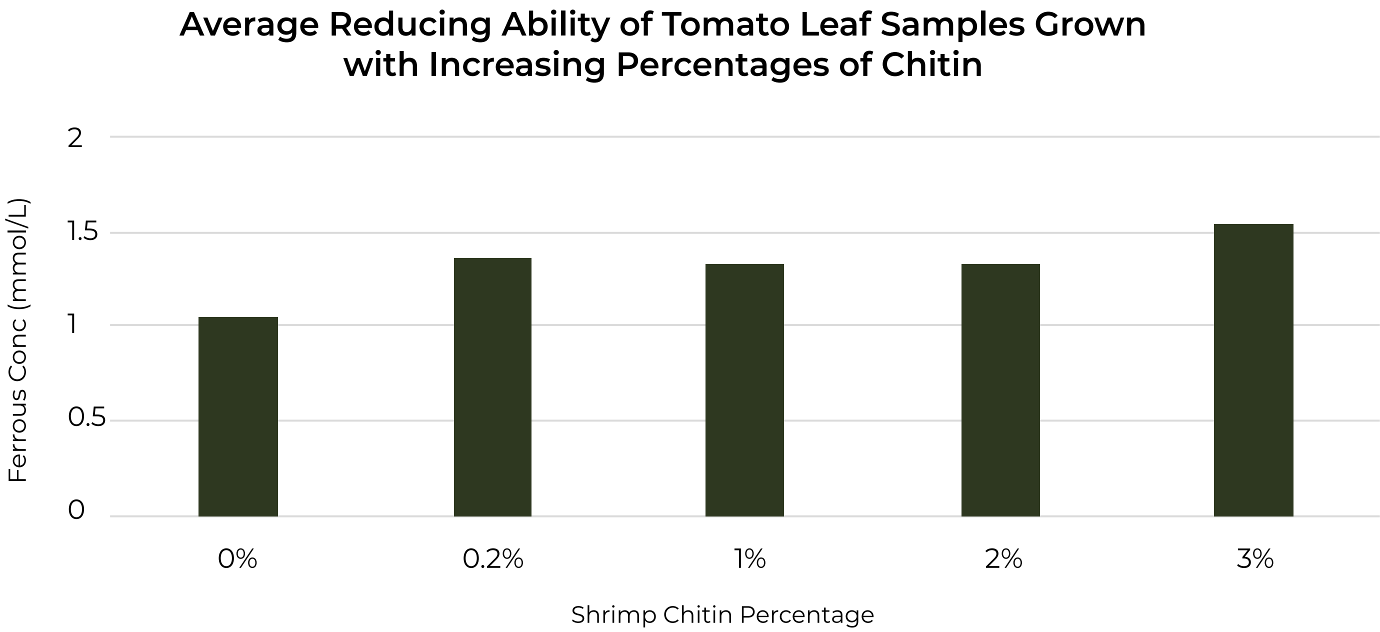
Tomato plants in growing media amended with increasing percentages of shrimp chitin.

A tomato plant trial is currently being carried out in which growing medium has been amended with chitin in dry weight percentages: 0% (control), 0.2%, 1%, 2%, and 3%. Preliminary measurements show that the chitin has not negatively impacted the growth rate of tomato plants since germination. The chlorophyll fluorescence and content of these tomato plants was also measured as a quantification of plant stress and results indicate that the chitin amendments are not causing any additional stress to the plants.

As fruit has not fully matured yet we tested tomato leaves to investigate if any differences could be found in antioxidant activity between treatments. Two assays were carried out: the Ferric Reducing Ability of Plasma (FRAP) assay which tests the reducing ability of a leaf sample as a measure of antioxidant activity, and the Folin's assay which measures the total phenolic content of a leaf sample. These assays are used in order to assess the potential health benefits associated with eating tomato fruit, and so were used here to test leaves for any trends in antioxidant activity and content between chitin treatments. As illustrated in the following graph, all tomato leaf samples grown with chitin showed a slightly higher reducing ability to the control.

The highest reducing ability was found in samples grown with 3% chitin. This trend was also found for leaf samples tested in the Folin's assay, in which it was seen that all leaves grown with a chitin amendment showed a higher total phenolic content than the control. When fruit has fully matured, it will be tested in the same way to see if a similar trend will be seen in the antioxidant activity and content of the fruit.

Graph representing the reducing ability, as a measure of antioxidant activity, of tomato leaf samples grown with increasing percentages of chitin in growing media.



HORTI-BLUEC
VR EXPERIENCE

Interactive user experience: examining a 3 D model of a root system.

With the help of a master's student, Finlay Whitfield, Edward also designed a virtual reality (VR) experience which walks the user through the Horti-BlueC project as a whole. This interactive experience allowed the user to grow a tomato plant using chitin from shrimps and examine a 3D model of a scanned root system.

BRITISH TOMATO
GROWERS ASSOCIATION

THE NUTRIENTS OBTAINED FROM AN AVERAGE ROUND

TOMATO

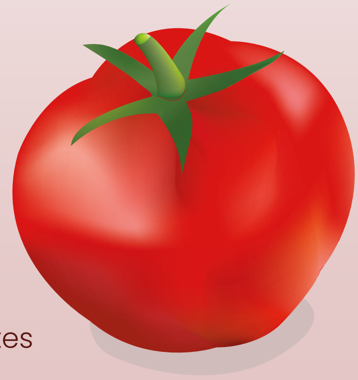
NUTRITION HIGHLIGHTS

NUTRITIONAL CONTENT (PER 100g) AND % OF RECOMMENDED DAILY ALLOWANCE (RDA)

18 kcal
Energy

1.2g
Fibre
(4% RDA)

3.89g
Carbohydrates
(1.50% RDA)



2.6g
Sugar
(2.89% RDA)

0.9g
Protein
(1.8% RDA)

0.2g
Fat
(0.29% RDA)

MINERALS

Potassium 237 mg (6.77% RDA)	**Sodium** 5 mg (0.21% RDA)	**Calcium** 10 mg (1.43% RDA)
Phosphorus 24 mg (4.36% RDA)	**Iron** 0.27 mg (3.10% RDA)	**Manganese** 0.114 mg (2.85% RDA)
Magnesium 11 mg (3.66% RDA)	**Zinc** 0.17 mg (1.79% RDA)	**Copper** 0.059mg (4.92% RDA)

ANTIOXIDANTS & VITAMINS

Lycopene <14.6 mg	**Vitamin C** <21 mg	**Beta-carotene** <1.1 mg
Phenolic acids <4.9 mg	**Lutein** <0.3 mg	**Phytoene** <1.3 mg
Flavonoids <8.2 mg	**Vitamin E** <1.8 mg	**Phytofluene** <1.2 mg

Infographic prepared for the British Tomato Growers Association article describing the nutritional content of a tomato.

Edward and colleagues also wrote an article for the British Tomato Growers Association earlier in the year which discussed the health benefits associated with eating tomatoes. This report details studies which have found potential benefits relating to cardiovascular health, immune system modulation and cancer prevention.

CONCLUSION
OF HORTI-BLUEC

The main conclusions from the project are:

Tomatoes can be grown on blends consisting of 100% local organic renewable materials without yield penalty; for strawberries replacement of peat and coir with 40 volume% local organic renewable materials was successfully tested. The spent growing media can be recycled after use in the greenhouse. Biochar can be used in renewable growing media during cultivation and C storage in the long term after cultivation.

Compost, biochar and chitin have specific effects on the microbial life in growing media blends, and thus have an added value for soilless cultivation.

Message:

1. **New growing media blends: organic renewable growing media:**

- As an alternative for mineral wool, peat or coir grow bags, tomatoes can be grown on 100% local organic renewable materials blends without yield penalty. This was tested at commercial scale. In some cases, the renewable blends with biochar gave the best yields.
- Strawberry grown on blends with 40 volume% local organic renewable materials was successfully tested, without negative effects on yield.
- No requirement or need for adaptation of the irrigation and fertigation strategy when using these new blends.
- Risk for saprotrophic fungi on woody materials in growing media blends: avoid too wet conditions, however these fungi are no real risk for the yield.
- The price of biochar should be expressed per volume and not on mass basis when used for growing media
- Composts in growing media blends allow for fertilizer replacement as they are a source of P and K and other nutrients, but N mineralization is too low to cover crop needs for N
- Composts in growing media may allow for lime replacement
- The next step should focus on economic feasibility of adding biochar to the blend and the future role of C credits (i.e., for not using the peat and for storing C in the field)

2. **Spent growing media can be upcycled:**

- Either upcycled by direct reuse, or as feedstock for compost or biochar production.
- The nutrient concentrations in spent media are relevant in terms of reuse, especially the P and K concentrations. In contrast, spent growing media have a low N release rate.
- Biochars based on spent growing media can be reused as P or K fertilizer
- Composts based on spent growing media can be used as bulk replacement in growing media
- The next step should focus on reuse of spent growing media with biochar included

3. Biochars for fertilizer replacement, disease resistance or bulk replacement in growing media:

- Biochars for fertilizer replacement:
    - biochars can be used in smaller amounts (as an amendment) for fertilizer replacement for P and K (but not for N) and eventually for lime replacement.
    - For fertilizer replacement, the biochar can be produced from feedstocks with high nutrient and salt contents, e.g. spent growing media.
    - Biochar as fertilizer may be more relevant for cropping systems without fertigation or fertilizer addition during the cultivation
    - The next step should focus on nutritional effects of biochar (added value or a risk)

- Effect on disease resistance:
    - For increasing disease resistance, the effect of biochar is highly depending on the feedstock and could only be observed when plants were growing in nutrient-limiting conditions (active inoculation)
    - No positive or negative effects of using biochar on diseases and pests were observed in the trials at commercial scale (no active pathogen inoculation)

- Biochars for bulk replacement in growing media
    - biochar production was optimised to produce an efficient growing medium
    - When starting from woody feedstocks, biochar can be used for bulk replacement in growing media since the biochar has an optimal structure and values for EC, pH
    - biochar should be first moistened before mixing in the growing medium blend
    - The next step should focus on producing biochar from greenhouse feedstocks including plastics, i.e., crop residues with clips, wires, ...

4. Chitin as microbial stimulant and source of mineral nitrogen:

- During decomposition when mixed in the growing medium, chemical or enzymatically processed chitins based on shrimp shells or the invasive Chinese mitten crab release a significant amount of mineral N within 4 weeks, with an increase in the microbial biomass in the growing medium and a change in the microbiome composition.
- Chemically extracted chitin has a high N Fertilizer Replacement Value: these chitins release mineral N, but may induce imbalances for other nutrients in systems without fertigation
- Thermal processed shrimp shells have a lower N release while they still contain other nutrients and salts
- Chitin has a positive effect when used in low concentrations: chitin can only be used as amendment in low concentrations (<2-5 g/L growing medium) to avoid hydrophobicity and other negative effects
- Chitin cannot be used for bulk replacement in growing media blends
- Applying chitin as flakes or powder in a growing media blend allows for a slow or medium release effect of this additive
- The next step should focus on appropriate dosing the chitin

5. CO2 and biochar production

- Gasification results in stable C and allows to replace natural gas and recover CO_2 from the chimney
- Thermal treatment of biomass results in up-concentration of nutrients
- More recovered CO_2 used in the greenhouse results in higher tomato yield but take care for toxic compounds (need for monitoring the gas quality). Dosing is related to ventilation: if windows cannot be opened, reduce the CO_2 dosage to avoid toxicity
- Timing and nature of the supplied CO_2 can be optimized based on crop demand rather than energy production

UPCOMING EVENTS

26th OCTOBER

9th symposium project partner and Interreg hybrid meeting in Portsmouth

27th OCTOBER

Final public facing in person dissemination event in Portsmouth. Please register here

09th NOVEMBER

Horti-BlueC Valorisation Webinar 4: New growing media blends for strawberry and tomato. Please register here

Youtube

Website

Twitter

Instagram

Interreg 2 Seas Mers Zeeën Horti-BlueC