GCRI TRUST VISIT REPORT

REPORT OF A VISIT TO THE MUSHROOM DAYS EXHIBITION, BRABENTHALLEN, DEN BOSCH AND CHERRY GROWERS, UTRECHT, NETHERLANDS, 22-24 April 2026

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Summary

Mushroom Days Exhibition, Den Bosch

The main developments since the last exhibition in 2023 were in reducing picking labour costs and attempts to improve sustainability by reducing peat in mushroom casing. Several companies displayed robotic harvesting systems assisted with AI algorithms which improved the prediction of harvestable mushroom positions and harvesting efficiency. These systems have now been installed on several commercial mushroom farms in Europe and North America. In Europe, the return on investment is estimated to be around 2 years. All the mushroom casing suppliers, and several research organisations are looking at reducing or eliminating peat from casing. Despite improvements, there is still no peat-free or peat-reduced casing that produces the same mushroom yield and quality at the same cost as peat casing. New exotic mushrooms (morels, cordyceps) are coming on to the European market from Asian suppliers – the cultivation systems are not yet sufficiently reliable to make this economic in Europe.

SWD Control on Dutch Cherry Farms, Utrecht Area

In the Netherlands, more than 90% of sweet cherries are now produced in polytunnels with netted ends. However, spotted wing drosophila (SWD) remains a serious pest, and as in the UK, the availability of pesticides for control is very limited. Low volume bait sprays with the product Combi-protec in a 5% v/v solution and less than 10% of the full rate of pesticide are now replacing full pesticide sprays because they are giving equivalent SWD control but with lower costs and less damage to beneficial organisms. Spray applications to cherries are made with conventional tractor -mounted or -trailed equipment with reduced numbers of nozzles, spray pressure and air volumes.

Mushroom Days Exhibition, Den Bosch

There were 122 exhibitors on 92 stands at the Mushroom Days exhibition. The busiest days were the Wednesday (which I avoided) and the Thursday. The quietest day (Friday) was the best day for visiting stands and meeting exhibitors. As usual, the focus of the exhibition was

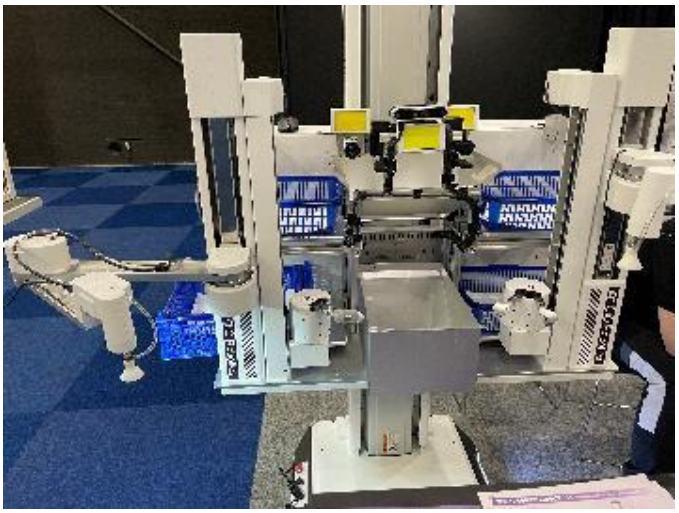
for cultivation and marketing of button mushrooms (*Agaricus bisporus*) but there were also a significant proportion of exhibits devoted to exotic mushrooms.

Growing Systems and Harvesting Equipment

The main cost of growing mushrooms is labour so it was not surprising to see several companies displaying fully mechanised and reduced labour picking systems. The use of AI algorithms indicated a large step forward in robotic harvesting systems since the last Mushroom Days exhibition in 2023. However, the displays were with artificial mushrooms or of videos of crops being harvested – it was not clear how successful the systems are in the real world with actual mushroom crops (e.g. quality of harvested product, number of failed picks). The Mycionics (Canada) and Festo (D) systems use a gripper system for harvesting mushrooms. The Mycionics system on display was combined with a Christiaens (NL) 'Drawer System' of mushroom cultivation where mushroom shelves are moved to the picking area from cultivation and storage rooms. The Forager HX800 from 4AG Robotics (Canada) and QiO Robotics (China) systems use sucker cups and can be fitted to pick from conventional shelves. These systems claim picking speeds of 16 – 30 mushrooms per minute. The latter claims a 95% picking success rate.

Robotic mushroom harvester from Mycionics

Drawer picking system from Christiaens



Robotic harvesting system from QiO Robotics

Yield prediction system from Funghii

Tilting shelf growing system and moving belt from GTL

An essential part of the improvement of the robotic systems is the use of vision systems and AI algorithms that can predict the development of mushrooms from 4 mm diameter to harvesting stage. This can also benefit manual picking such as in the equipment from Funghii (B). These AI assisted systems ensure that mushrooms are picked at the optimum stage. Machinery for improving manual picking speeds by placing uncut mushrooms on to a moving belt (GTL) or revolving disc (Vandentop, NL and Christiaens) was on display, as well as the tilting shelf system from GTL.

Mushroom Machinery and Irrigation

New equipment from MushComb (NL) included a casing transport wagon for storing casing overnight ready for filling the next day, and an automatic block plastic unwrapping machine. This facilitates the disposal of separated spent compost from plastic wrapping. A Netafim drip irrigation system was on display on the Nutrigain (UK) stand – the system was on display with a Polish wood fibre-based casing which holds less water than peat casing; the continuous supply of water from the drip irrigation system is claimed to make up for this disadvantage.

Mushroom Spawn and Strains

Amycel presented a new brown strain ‘Kodiak’ which crops 1.5 – 2 days faster than the traditional ‘Heirloom’ brown strain. It will be interesting to see whether Kodiak replaces the industry standard Heirloom strain and other brown strains currently grown on mushroom farms. Other Agaricus spawn producers with exhibits included Sylvan/Euromycel (US/F), Italspawn/Hollander (I), OurCelia (NL), and Spyra (PL). There were no major changes in white mushrooms strains on display, with strains such as A15 (Sylvan) and Exxcalibur

(Amycel) still being the main products. In India, where 98% of the production is Agaricus, Milkway is a major supplier of Cheetah Spawn. Production in India is on casing made from coir and river clay.

Mushroom Casing

Extraction sites for peat are reducing – in Ireland there is a limit of 30 ha on sites, and there are also limits in Germany, so there is continuing interest in peat alternatives. Although peat-based products still dominate the mushroom casing market, most of the casing manufacturers at the exhibition had a peat-free or peat-reduced product on display. These included McDon (Northern Ireland), Harte/Floragard (Ireland), BVB (Netherlands) and Wokas (Poland). Substitute materials that were disclosed included wood fibre and processed canary grass. Maximum inclusion rates of peat alternatives in commercially available mixes are generally around 30%. Discussions with stand holders indicated that the peat-free or reduced-peat products still represent a small proportion of the total casing sales (less than 10%). Most of the peat-reduced products are sold in Europe – exported casing is still peat casing. The main obstacles to peat substitution are a higher casing cost (generally 50% or more) and reduced mushroom yields compared with 100% peat casing. The Wokas casing has produced good mushroom yields on Polish mushroom farms but costs x3 peat casing.

Peat-free mushroom casing from Wokas, Poland

Exotics Substrate and Cultivation

A large display of exotic mushrooms was on the stand of Fresh Mushrooms Europe (B). This included species that are cultivated in Europe (oyster mushrooms, shiitake and horse mushrooms), cultivated species that are imported from Asia (morels, cordyceps) and species that are only collected from the wild (ceps, chanterelles, St. George's mushrooms). The yield of morels is currently too low and unpredictable to make this viable in Europe. Cultivation of horse mushrooms in Europe stopped some years ago due to EU heavy metal limits in mushrooms, but these have since been increased making cultivation feasible again. Mycelia

had a stand also displaying a range of exotic species that can be cultivated including new sporeless oyster mushroom strains. Other suppliers of exotic mushroom spawn and substrates included CNC Substrates (NL), Eurosubstrat Callac (F), Gurelan Mycelium/Sylvan (ESP), and Mushroom Spawn (China).

Morels and horse mushrooms on the stand of FME

Pest and Disease Control

Entomopathogenic nematodes such as the product nemycel from e-nema (D) have been used for many years for control of mushroom sciarids. The company also had a display of the product nemycel being used for the control of mushroom phorids and cecids. Mertens (NL) also had a similar nematode product, Entonem from Koppert on their stand.

Research and Development

Several universities and research institutes displayed results on a ‘Science Island’. Research at INAGRO (B), Teagasc (IRL) and University of Sydney is examining peat alternatives for casing. The best performing materials at INAGRO were some sources of wood fibre, biochar (not yet widely available) and small proportions of bentonite. Spent mushroom compost and some sources of wood fibre encouraged moulds. Recycled strawberry growing media is still largely peat-based in Belgium. Demonstration crops are being conducted on mushroom farms in Spain, Belgium, Italy, Belgium and Switzerland as part of an EU funded project Peatless. Good results had been obtained at Teagasc using up to 70% wood fibre in peat casing. Mushroom research at Wageningen University is concentrating on detecting viral, bacterial and fungal pathogens with TaqMan assays. A project at the University of Warwick is examining the use of genetically modified oyster mushroom strains for producing valuable products (e.g. pharmaceuticals).

Visits to Cherry Growers, Utrecht, to See Methods of SWD Control

Sweet cherries were traditionally grown in the Netherlands as an outdoor crop but now more than 90% of cherries in the Netherlands are grown under polythene tunnels with netting mesh on the ends. A range of sweet cherry varieties are grown so harvesting is from May to September. Late crops are very susceptible to spotted wing drosophila (SWD).

Fruit Research Centre, Randwijk, Wageningen University

A discussion was held with Herman Helsen, head of the Fruit Research Centre. The Fruit Research Centre has a commercial area of several varieties of sweet cherries under polythene tunnels with mesh screen ends. There are also soil pot grown cherry trees in experimental plots with 3 pots of cherries surrounded by mesh screens for smaller scale experiments. Most work on SWD has been on soft fruit and cherries; no work has yet been done on blueberries. As well as bait sprays, the centre is looking at the use of parasitic wasps and sterile males for SWD control.

Commercial scale cherries at Fruit Research Centre, Wageningen University

Pesticides and bait sprays for control of SWD in cherries

As in the UK, pesticide options for control of SWD in cherries in the Netherlands are very limited. Only two applications of Tracer (spinosad) are allowed per year. Exirel (cyantranilprole) can be applied every 3 years (this will be every 2 years from next season). There are no emergency pesticide approvals and no pesticides are approved for grapes.

Bait sprays with the German product Combi-protec and low doses of pesticides (Tracer of Exirel) are now replacing full pesticide sprays. Combi-protec is approved as an adjuvant in the UK, Netherlands and some other EU countries. The cost is around 200 Euros per 5 Litres. A similar but significantly cheaper bait product (ProBandz produced by Russell IPM) is approved as an adjuvant in the UK. A bait spray containing a 5%v/v solution of Combi-protec, with 1-10% of the approved rate of Tracer, applied at 40 L/ha has given good control of SWD, equivalent to full rate sprays of Tracer. Good control of SWD has also been obtained with 10% of the approved rate of Exirel and 20% of the full rate of Decis (deltamethrin - not currently approved in the UK or Netherlands for commercial cherries).
A tractor-mounted Lochmann air-assisted sprayer with a 600 L tank capacity is used to apply Combi-protec bait sprays to cherries at 40 L/ha. Only one nozzle halfway up the set of 9 spray nozzles is used on each side. The nozzles produce a 120 degrees fan of large droplets which fall as a cascade on to foliage. The air volume is reduced to 10%. The pressure is set at 1.5 bar. Tractor speed during application is 4 – 5 km/h.

<u>De Kersenhof, Cothen</u>

A discussion was held with the farm owner, Erik Vernooij. About 20 varieties of sweet cherry are grown under polytunnels in which picking starts in the 2nd week of May and ends in September. Trees are spaced at 4 metres by 1.3m. All crops are grown under polythene cover with netting protecting the ends of the tunnels. Good control of SWD has been obtained using Combi-protec bait sprays (5% v/v solution) with 1% of the full approved rate Tracer, applied at 40 L/ha. Exirel bait sprays (10% of full approved rate) are only used when SWD larvae damage is found in the fruit later in the season. Full pesticide sprays are no longer used for SWD control.

Polytunnel cherry crops at De Kersenhof

Lochmann and Munckhof sprayers at De Kersenhut

Method of bait spraying

Two types of tractor-trailed sprayers are used for applying Combi-protec bait sprays at 40 L/ha: (1) Lochmann with 1500 L tank (2) and Munckhof with 1000 L tank capacity. A pressure of 2 bar or less is used for both sprayers.

The Lochmann sprayer is air assisted and is used for applying Tracer sprays where air assistance is needed to reduce spray drift (a regulatory requirement). For wide row spacing (more than 4 metres) it is always necessary to have some air assistance (about 10% of full setting). For row spacing of 4 metres or less, the air assistance can be switched off (except for Tracer due to the above regulatory requirement). However, the Lochmann sprayer is more difficult to use than the Munckhof. Older orchards with dense foliage need 2 nozzles (top and middle) but for young trees only the top nozzle needs to be switched on. Orange Albuz nozzles are used. Larger

droplets are preferable. The tractor speed is 4-5 km/h. Due to the large 1000 litre tank size, the last 20 litres at the end of spraying needs to be discarded. It is recommended that a practice spray is conducted with only water in the tank before bait spraying is undertaken.

Personal Statement

This GCRI Trust Visit has given me the opportunity to see the latest developments in the Dutch mushroom and cherry industries. Contacts were made with several manufacturers, grower companies and research organisations that are potential partners in future research applications. This will enable Microbiotech to work with UK and overseas growers in preparing research proposals. In particular on:

- Reducing peat in mushroom casing and other horticultural substrates
- Cultivation of mushrooms in hot climates
- Mechanising the application of bait sprays to fruit crops
- Testing different pesticide and biocontrol products for SWD control.

I would like to thank the GCRI Trust for giving me the opportunity to undertake this interesting and productive visit.

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