GCRI TRUST VISIT REPORT

REPORT OF A VISIT TO THE MUSHROOM DAYS EXIBITION, BRABENTHALLEN, DEN BOSCH NETHERLANDS , 10 to 12 May 2023

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Summary

The 36th Mushroom Days exhibition was a postponed event from 2022 and was the largest to date with 109 stands covering all aspects of mushroom cultivation. The emphasis for new developments in this years' exhibition was on growing and picking systems to reduce labour and on sustainable growing substrates. No 100% commercial peat-alternative casing has yet been developed although there were several partial peat replacement casings. There was a greater emphasis on exotics in terms of spawn and substrate suppliers reflecting the increasing importance of this sector. The main new developments on display were:

- Commercial peat reduced casings using wood fibre or maize crop residues
- Fully robotic mushroom harvesting system from Mycionics
- Tilting shelf systems from GTL, Christiaens and Tilting Shelf Systems
- Conveyor systems for automatically trimming and grading mushrooms
- UV light treatment of mushrooms in punnets to boost vitamin D
- Supplement and biocontrol products that can suppress fungal diseases
- A nematode product for control of phorid flies

Growing Systems and Harvesting Equipment

Mushroom picking costs and labour shortages are universal challenges in the mushroom industry. It was therefore not surprising that a major aspect of the exhibition was on systems that either reduce picking times for hand labour or dispense with hand labour using robotic systems.

The Northern Ireland company Axis Systems has developed a mushroom harvesting conveyor whereby pickers put untrimmed mushrooms with both hands into a fingered conveyor. The system then takes the mushrooms to a packing area where they are trimmed and graded. It is claimed that the system can increase harvesting speeds x4 compared with conventional hand picking.

The Christiaens 'Drawer System' brings growing shelves to a central picking area where the mushrooms are picked into a rotating wheel (carrousel) finger. The mushrooms are then automatically trimmed, graded and packed. On their tilting shelf system, the shelves can be tilted towards the picker to make picking easier and faster. The mushrooms are picked on to a conveyor to a grading and packing machine.

Tilting growing room shelves were also on display from Tilting Shelves Systems (Belgium) and GTL Europe (Netherlands). The Canadian company Mycionics displayed a fully robotic harvesting system which it claims can pick 45 mushrooms per minute and reduce picking costs by 50%.

Axis Systems Harvesting Conveyor

Mycionics robotic harvester for Christiaens drawer system

Tilting shelf system from GTL Europe (left) and Tilting Shelves Systems BV with TLT Automation harvesting system (right)

Mushroom grading and packing

A wide range of grading and packing equipment was on display including the British company Omori. They have produced a polythene alternative 'flowpack' in which mushrooms are packed into containers sealed in 'envelopes' instead of overwrapped. Viscon (Netherlands) have developed a xenon pulsed light system for boosting the vitamin D content of mushrooms. The mushrooms in punnets are pulsed for less than two seconds which increases the vitamin D content 2-4 times.

Mushroom Machinery and Climate Control

Mushroom farm machinery such as shelf equipment, head-end fillers etc was traditionally supplied by Dutch companies. However, there is now increasing global competition from suppliers such as Agro-Projects and Lucky Grower in Poland, Scully Grower Supplies (Ireland), Vierrebi (Italy) and Zhejiang Hongye Equipment (China).

New equipment on display included the Alpie (Itlay) E-wash system for cleaning shelves – increasingly important when cook-out is not used because of high energy costs. Christiaens have developed a new casing separator which removes casing from compost during shelf emptying.

The Dutch company AEM is now offering a climate control system for cultivation of exotic mushrooms due to the increasing importance of this sector. The emphasis for the new Fancom climate control system is energy saving – outside air is used where suitable so unnecessary heating and cooling is avoided.

Mushroom Casing

The main priority for casing producers was to find a peat alternative for the European mushroom industry. Kekkila-BVB (Netherlands) are part of the EU funded Bioschamp project and will have a 30% peat replacement casing commercially available in the next year. The company now has a new fully enclosed casing production facility. Legro also has a new casing production site. They are cooperating with Cormo to produce a peat-reduced casing based on the Cormo material made from maize crop residues. Harte have produced a 30% peat reduced casing which is commercially available and are currently working on 50% and 100% peat replacement blends.

Wokas (Poland) supply a range of peat-based materials with fine to thick structures depending on the type of mushrooms grown and they also produce a dried blend for export. Other peat casing producers with stands at the exhibition were McDon (Northern Ireland) and Sterckx (Belgium).

Mushroom Compost and Compost Supplements

Several suppliers of Phases 2 and 3 compost had exhibits but there was no new development in the composting sector since 2019. Exhibitors included Coenegrachts Substraat, Sterckx (Belgium), CNC, DTO, Hooymans Substrates, Walkro (Netherlands), Pilzhof (Germany) and Holpol-Compost (Poland).

MCSubstradd have introduced an NIR analysis programme for composts, straw, manures and goody water which can a analyse samples for moisture, nitrogen, ash and other parameters in under two minutes.

MCSubstradd displayed a range of Phase 2 and 3 compost supplements, including a new product MCS 2Break which is suitable for low protein composts and a two-flush cropping schedule. There were also exhibits from two of the largest supplement producers Champfood and Superchamp (Netherlands).

Nutrigain had information on a casing watered-on supplement (MycroNutrient) that increases mushroom yield and quality in the second and third flushes. There is also suppression of cobweb and dry bubble diseases, and the product can be used to boost vitamin and selenium contents in mushrooms.

Mushroom Spawn and Strains

The main Sylvan fresh market white strain remains A15, with 512 and 520 also being suitable for mechanical harvesting. Sylvan have introduced a new brown Agaricus strain Tuscon 820 as an alternative to the main brown strain in use, Amycel Heirloom. Sprint is a new grain-based spawn carrier introduced by Sylvan which gives a faster spawn-run than traditional grain spawn.

Amycel have introduced a new white Agaricus strain Excalibur which produces large heavy bodied mushrooms. It is also claimed that this new strain reduces clumping and improves picking speed. The main white strain from EuroMycel (France) is E-58. The company currently markets most of it spawn in Poland

Italspawn & Hollander Spawn (Italy & Netherlands), Ecovative Spawn (previously Lambert Spawn) (USA) and Spyra (Poland) also had stands at the exhibition with a range of white and brown Agaricus strains. A new company at the exhibition was Milkyway Spawn (India) which is the main spawn producer on the Indian subcontinent.

Exotics Substrate and Cultivation

There were several exhibits from manufacturers of exotic mushroom spawn substrates. Mushrooms on display included oyster and king oyster mushrooms (*Pleurotus* species), Shiitake, Pholiota and blewits (*Lepista nuda*). Substrate producers included CNC Exotic Mushrooms BV, VEME Special (Netherlands), Agrinoon Enterprise (China), Eclo, Mycelia

(Belgium), EuroMycel (France), Holpol-Compost (Poland), Shroomwell Biotech (Estonia) and Unicorn Bags (USA). Spawn producers included Amycel, Ecovative (USA), Milkyway Spawn (India), Mycelia, Shroomwell (Estonia), Shandong Exotic Fungi (China) and Sylvan.
A new area on display was the use of mycelium technologies for production of fashion items, plastics and wood alternatives by Ecovative.

Pest and Disease Control

The German company e-nema had a display of nematode products for fly control in mushrooms. In addition to Nemycel (*Steinernema feltiae*) which is used for sciarid control, the new product Nemycel Phorid is used for control of phorids. Both products are applied to the casing after filling. e-nema also market products based on *Heterorhabditis bacteriophora* and *Steinernema carpocapsae* for a range of soil-dwelling pests in other horticultural sectors. Mertens (Netherlands) also had the nematode products Nemycel and Scia-rid (Koppert) on display. They also market products based on bacteria (*Bacillus thuringiensis*) and fungi (*Beauveria basiana*) for sciarid and phorid fly control in mushrooms.
Mennon (Germany) were exhibiting a disinfectant for mushroom cultivation (Menno Floriades) based on benzoic acid. Nutrigain (UK) were advertising their Sporekill fatty acid disinfectant for use in mushroom cultivation.

Mushroom advice and consultancy

Mushroom Signals (Netherlands) provides an education and training programme for mushroom composting and cultivation. The learning programmes are a combination of on-line training, e-events and on-farm courses.
Mycelia-Academy BV (Belgium), Salai International Japan and the Japanese Exotic Mushroom Journal provide advice and training on the cultivation of exotic mushrooms.

Research and Development

There were several stands with posters from organisations in Europe, North America and Australia.

- Bioschamp is a four-year EU funded project involving 13 partners. The aim is to produce a sustainable low-peat casing and to reduce the dependency on pesticides by 90%. The project is focusing on the use of locally available biomass to produce a partially ‘circular economy’ casing. Bacillus species are showing some suppression against dry bubble disease.
- Work at Teagasc in Ireland is examining the chemical and biocontrol of mushroom fungal pathogens. Cobweb disease caused by Cladobotryum species has become

resistant to Vivando. Bacillus species are showing some suppression against cobweb in the first flush.

- The Beyond Peat project at Teagasc is screening a wide range of organic materials as potential substitutes for peat in casing. Bark was to find to have potential to replace a proportion of peat in casing.
- Work at INAGRO in Belgium has been examining how to get higher and more consistent temperatures during Phase I composting. Basing the fan speed of the aeration system on compost oxygen has reduced the cooling effect and increased compost temperatures.
- Work at the University of Sydney is examining the microbiobome of Phase I composting. In particular, the influence of phages on the compost bacteria is being studied.
- The SoftGrip EU project led by the Biorobotics Institute in Greece aims to develop a soft grip and vision system for a robotic mushroom harvester. Bruising of mushrooms is a particular problem of robotic harvesting. By mimicking hand harvesting, the robotic picking arm will avoid damage to mushrooms caused by previous suction cup harvesting systems.
- A project at the University of Wageningen is examining the vegetative incompatibility of mushroom strains. If strains such as A15 and Pearl are mixed in compost, there is a large decrease in mushroom yield. The mechanism of strain incompatibility is currently unknown but this project amins to develop a screen and a genetic marker for strain incompatibility.
- The University of Utrecht is investigating the transport of nutrients from the compost substrate into the mushroom fruitbodies using radiolabelled techniques.

There were also stands from three other mushroom research providers: Pennsylvania State University, Agrifood & Biosciences Institute (Northern Ireland) and Asochamp in Spain. The ISMS stand had information about the next ISMS Congress in Las Vegas, Nevada, February 2024.

Personal Statement

The meetings with the six mushroom casing producers at the exhibition were especially useful because it gave me an up to date view on the future availability of peat casing. This will affect the UK industry as well countries that export their mushrooms to the UK. There is still a plentiful supply of peat in bogs with extraction licences or permits that can be used for making mushroom casing for many decades. It is government legislation and retailer

pressure that will decide whether this peat can be used for growing mushrooms in different countries.

As well as an increasingly wide range of commercial suppliers in the mushroom industry, there was a greater emphasis in this year's exhibition on mushroom research and development in different countries. This has enabled me to discuss the latest developments on sustainable mushroom substrates and pest and disease control with researchers from Australia, Ireland, Belgium, Germany, Netherlands, South Africa, Switzerland, and USA. I discussed research on mushroom diseases with Dr Jan van der Wolf of the Wageningen University, and experimental work on casing materials with Dr John Pecchia of Penn State University and David Iaconi of Mushroom Supply and Services Inc, Pennsylvania. Despite a large research effort by several groups, there still not an alternative casing material that gives the same yield performance as peat casing.

The withdrawal of fungicides such as Sporgon and increasing pathogen resistance to Vivando has made the search for biological disease control in mushrooms important. There has been some success in the Bioschamp project and at Teagasc in using suppressive Bacillus species to control cobweb and dry bubble diseases. The increasing energy cost has made regular cooking-out at the end of crops unviable so that diseases such as virus-X have become more prevalent. Improved farm hygiene and effective disinfectant products will become increasingly important.

As a result of these contacts, Microbiotech Ltd will be setting up new research projects on mushrooms with science and business partners from several of these countries. This includes research projects on:

- New sustainable casing materials
- Mushroom disease control using biocontrol agents
- Control of phorid flies using biocontrol methods
- Substrates for cultivation of exotic and pharmaceutical mushrooms.

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

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