

GROWING THE FUTURE TOGETHER

The 2022 AMGA conference

By Dr Jenny Ekman

At the end of October, the mushroom industry will meet in Adelaide for the first industry conference in several years. With a diverse speaker program, the conference provides a unique opportunity to learn about new advances in research, farm practice and marketing initiatives, as well as offering great networking opportunities.

This year, the AMGA conference will host suppliers, growers, farm owners and well-respected national and international speakers.

Following farm tours on day one, day two of the conference (Thursday 27 October) is dedicated to international speakers. A wide range of presentations will focus on topics critical to the ongoing sustainability of the industry, including harvest mechanisation, new variety development and alternative casing materials.

Three of the great range of international guests are profiled below.

- Jack Lemmen from GTL will outline the development of more efficient harvesting systems, including advances in robotic picking.
- Reflecting the changes in consumer attitudes to exotic mushrooms, Jorge Calvo from Sylvan will present an overview on the market for exotic mushrooms in Europe, with a focus on oyster, shiitake, and king oyster.
- Dr Ralph Noble from the UK and Folkert Moll from Kekkilä-BVB will discuss issues surrounding the sustainability of peat as casing and possible alternatives to this vital commodity.

Picking the best from harvest practices

Mushrooms are already a technology-intense crop. More than any other, they rely on precise control of substrate, climate, nutrition, and irrigation. Many aspects have been mechanised, with computer-controlled compost production, bulk phase 3 compost, automatic casers and fillers and many other technological aids.

However, the most important part of cropping – harvest – is still entirely done by hand. Many growers were already struggling with rising labour costs before COVID-19.

In recent months, the difficult situation resulting from numerous unfilled positions has been exasperated

by illness-derived labour shortages. Added to the major cost of labour to growers is now the almost daily worry of worker availability.

For more than 30 years engineers have been trying to develop a robotic mushroom harvester. This is no easy task. Mushrooms need to be picked gently, trimmed appropriately, and placed into grades according to size and shape. A firm touch or sharp edge can easily disfigure or bruise mushrooms. Furthermore, as mushrooms are not regularly spaced on the beds, picking single



mushrooms from clustered groups poses another special challenge.

Initial robotic harvester designs had limited success. Silsoe Research Institute developed an early robotic harvester in 1993¹. A suction cap attached to each mushroom, which then twisted and lifted the mushroom. While it could locate 84% of mushroom targets, only 57% were picked successfully. Overlapped or closely packed mushrooms were the most difficult to pick.

Technology has come a long way since the 1990s, and so has the search for robotic mushroom harvesting. A quick Google search reveals at least 10 companies (and universities) involved in developing commercial harvest technology for mushroom farms.

Any such technology is inevitably going to be capital-intensive. A potentially less expensive approach is to develop ways to increase efficiency of human pickers. This may mean using single layer beds, or moveable and/or tilting trays.

One company working on both options is GTL Europe. The company was initially formed in 1994 by Jack Lemmen as a tiny start-up in a shed beside his parents' house. In 2013 he merged with three companies:

Geraedts, Thilot and Lemmen. This has given the larger group expertise in air handling and control, composting and growing equipment, and waste management.

GTL Europe is now a globally recognised company involved in all levels of mushroom cultivation. It offers solutions to compost producers and farms including construction design, climate control systems, machinery, and automation solutions.

Jack Lemmen will be presenting at the 2022 AMGA conference on some of the latest developments in automation on mushroom farms. According to Jack, "The tilting shelves system was just the beginning. It is really the starting point towards a fully integrated harvesting system. Technological developments such as robotics and artificial intelligence are creating an array of opportunities to further optimise the harvesting process."

Huge improvements have been made in scanning, grading, and packing equipment for many fresh horticultural industries. Perhaps it is time for a great leap forward for mushrooms. Jack is certainly well qualified to give insight into what new technologies are becoming available, and potential benefits for the mushroom industry. It is certain to be a fascinating subject.



1 Reed JN and Tillett RD. 1993. Initial experiments in robotic mushroom harvesting. *Mechatronics* 4:265-279.

Pleurotus and Shiitake growing methods

It's not often we mention the "E" word - exotics - in Australian mushroom communications. With an industry (and levy) very firmly based on *Agaricus*, production of exotic mushrooms such as shiitake, oyster, king oyster, and lion's mane has been outside industry concerns.

However, a number of things have changed in the last few years.

The first is an increasingly adventurous, Masterchef-inspired consumer, interested in trying new tastes and flavours. However, our favoured Asian cuisines are definitely not *Agaricus*-centric. As noted in the previous MushroomLink journal, *Agaricus* production in China ranks a distant fourth behind shiitake, oyster, and black wood ear, and is closely followed by enoki and king oyster. At least 60 mushroom species are cultivated commercially, with many others collected for sale.

The second factor is the increasing availability of imported spawn and substrate for exotic mushroom production.

People who found themselves out of work due to COVID-19 restrictions discovered that they could set up a small mushroom farm in their backyard, with nothing more than a few plastic tubs, some racking, and a second-hand refrigerated shipping container. There are even kits for growing exotic mushrooms at home (along with other COVID-19-distractions such as sourdough starter and espresso machines...).

Such start-ups make for great visual appeal. Articles about ex-baristas discovering the joy of growing fungi



Oyster mushrooms

at their "city farm" have found their way onto Landline, ABC Rural and many local newspapers.

While such small operations remain at the fringe, more commercial operations are also starting to experiment with some of these new species. Such trends are likely not unique to Australia, but also occurring in other countries.

While this innovation may grow the mushroom category as a whole, it also presents a potential reputational risk to the mushroom industry, as new growers of exotic mushrooms are likely to lack knowledge of postharvest handling and good food safety practices.

Sylvan is the world's largest producer and distributor of mushroom spawn, with facilities in 16 locations serving 65 countries. They carry a wide range of white, off-white and brown *Agaricus* strains, which can be combined with a variety of different carriers and various growth supplements. However, they also produce a vibrant array of oyster mushrooms, coming in colours ranging from dark chestnut brown to ivory white and brilliant yellow. There are also shiitake, king oysters and wood blewits within their catalogue.

Sylvan have long participated in Chinese mushroom days and have been a major sponsor for this event for at least six years. Sylvan's European commercial manager for exotic and territory sales in Spain, Jorge Calvo has participated in many of these events.

Jorge will provide an overview of the market for exotic mushrooms in Europe, with a focus on oyster, shiitake and king oyster, at the 2022 AMGA conference. He will also discuss optimal methods of production for these mushrooms, including substrate production, incubation, and growing techniques.

As production of exotic mushrooms increases, the industry has a choice to either compete for market share or expand the category as a whole. *Perhaps it is time to consider the latter.*



Future materials for mushroom casing

Dr Ralph Noble is one of the key international speakers at the upcoming AMGA conference (26-28 October 2022).

Ralph is an applied microbiologist who has had a special interest in mushrooms since 1984. After a distinguished government and university research career spanning 34 years, he more recently moved into private enterprise, co-founding Microbiotech in 2017. His interests with the company include the use of different raw materials for mushroom compost, non-chemical methods of pest and disease control, and substrate supplements and casing.

Ralph has previously published several papers on partial replacements for peat in casing. Due to environmental concerns, mushroom businesses have been searching for alternatives to peat since the 1970s. Increasing costs and disruption of global transport have added extra pressure to finding alternatives to peat for mushroom farms.

In Ireland and the UK, a radical phase out is underway, with a schedule to eliminate all horticultural uses of peat by the early 2030s and possibly earlier.

However, finding alternatives is not easy. Peat has been the main component of mushroom casing since it replaced soil in the 1950s. While mixtures have changed over time, peat plus chalk or lime has proven ideal for mushroom casing. When combined with new mushroom spawn strains and composts, casing with peat has been one of the key factors improving yield and quality.

A good casing material needs to have a number of specific features including:

- High water holding capacity
- Low salt content
- Low cost
- Readily available
- Does not stick to mushrooms
- Does not contain pathogens or contaminants
- Does not encourage growth of moulds.



Ralph and his colleagues have trialled a number of alternatives to peat over the years, generally as partial substitution rather than complete replacement. These include:

- Composted bark fines
- Mature compost from green waste
- Recycled cooked-out casing
- Recycled spent mushroom substrate
- Coconut coir
- Recycled granulated waste rockwool slabs
- Filter cake clays
- Paper waste
- Fine particle coal tailings.

According to Ralph, one of the biggest issues with products such as pinebark fines, coir and other organic materials is that they are easily infected with mould, especially green mould (*Trichoderma* spp.).



Coconut coir, granulated rockwool, coal tailings and composted green waste; just a few of the materials proposed as partial replacements for peat

“While good results can be obtained using spent mushroom substrate, the issue is concentration of salts,” says Ralph. “Not only is a lot of water required to leach salts from the material, there must also be a disposal method for the contaminated leachate.”

Recycling the casing material itself may be a better solution. The MushComb casing separator provides a way to collect the casing, which can then be re-wetted. According to Ralph “we’ve found you can use about a third recycled casing without affecting yield or quality. Once you go above this the salt content starts to cause problems, and yield will go down.”

“The other problem is that with this system we’re still using peat. It’s not clear whether you could recycle a non-peat based casing material. And of course this relies on good pasteurisation to prevent carryover of pests and diseases.”

Green waste compost is also a possibility. Trials at the Marsh Lawson Mushroom Research Unit (MLMRU) by Adam Goldwater (AHR) have shown that adding up to 50% well composted green waste to peat as casing still provided good yields (see figure below). While this material is cheap and abundant, quality is highly variable. The three batches of material used in the MLMRU trials were all clearly different. This is a common issue, as is the potential presence of unacceptable contaminants.

There are also a range of other bi-products from other industries which may be used as part of a casing mix, such as sugar beet lime, de-watered clays and recycled rockwool. As these have different water-holding

qualities, the best material could be a blend, combining strong water holding properties with the mushroom cleanliness and casing structure provided by peat.

“For example, we have found that a 70% bark; 30% filter-cake clay blend can make a suitable casing material for mushrooms,” explains Ralph.

Coal tailings can also make a suitable additive. Research published by Dr Noble back in 2004* demonstrated that addition of 25% coal tailings (CT) to various different types of peat did not affect yield. Moreover, there was some benefit, as dry matter was significantly higher in the mushrooms grown with CT amended casing.

However, peat qualities are hard to match when it comes to choosing a casing material.

As well as showcasing some of his work on alternative casing materials, Ralph’s presentation at the 2022 AMGA Conference will discuss:

- The properties of peat that make it suitable for mushroom casing
- Effects of casing material on mushroom quality
- Future availability of peat in different countries
- New research and commercial developments on alternative casing materials, and which materials may be suitable for Australian growers
- How irrigation, management of pests and diseases, and other aspects of mushroom culture need to change in a peat-free world.

It should be a fascinating discussion.



Mushrooms at the MLMRU cased with peat only (left) 25% recycled organics plus peat (centre) and a 50:50 recycled organic:peat mixture (right)

* Noble R and Dobrovin-Pennington A. 2004. Use of fine particle tailings in mushroom casing. Mushroom Science 16: 335-341.

FULL INTERNATIONAL GUEST SPEAKER PROGRAM

Speaker	Presentation	Country
Roland van Doremaele - Christiaens	Robotics	Netherlands
Ger Hendriks	Compost	Netherlands
Dr Ralph Noble - Microbiotech	Casing Alternatives	United Kingdom
Folkert Moll - BVB	Casing Sustainability	Netherlands
Jorge Calvo - Sylvan	Exotic Mushrooms	Spain
Brigette Hendrix - Mushroom Harvesting Consultancy	Harvesting	Netherlands
Anne-Marie Arts - The AgriChain Centre	Climate Change, Pathogens and Food Safety	New Zealand
Maksym Yenchenko	The Ukraine Mushroom Industry	Ukraine
Jack Lemmon - GTL	Robotics	Netherlands

DAY THREE

The final day of the conference is dedicated to Levy Investment updates, with topics ranging from economics, the nutritional value mushrooms (see pages 35 and 5 for more detail on these projects), food safety and risk management, managing nitrogen supply in mushrooms (see page 24 for our feature on nitrogen and compost), pests and disease updates, and the latest from the Marsh Lawson Mushroom Research Centre.

A small sample of the highlights of day 3 are presented below:

Mushroom quality and safety, Dr Jenny Ekman

MushroomLinks's very own Dr Jenny Ekman is collaborating with the AMGA's Leah Bramich and industry expert Clare Hamilton-Bate on a levy project dedicated to delivering food safety services to growers.

In her presentation, Jenny will showcase the resources that are available to growers through the MU20000 project, and how they can use these to reduce risk.

The Australian mushroom industry has long been at the forefront of assuring food safety. It was one of the first industries to develop a HACCP plan, and has always been committed to ensuring mushrooms are safe to eat.



As well as grower resources, the Mushroom Food Safety Extension and Adoption (MU20000) project is developing an information library, offers food safety training, and provides 'Act and React' industry support.

Through the project, industry members are also eligible for a **FREE** annual test of mushrooms and water for microbial, chemical, and heavy metal contamination, meeting the requirements of certification bodies such as Freshcare.

However, not all growers have customers that require them to have a third party audited food safety program in place. The project team have therefore developed a simplified food safety standard specific to mushrooms. 'Safe mushrooms' can be used by growers to demonstrate due diligence without the cost and complexity of other programs.

With Jenny's 20 years plus experience in horticultural research and her highly regarded skills as a science communicator, her presentation is not to be missed.

Marsh Lawson Mushroom Research Centre Update, Dr Gordon Rogers

Managing Director of Applied Horticultural Research and Adjunct Professor of Horticulture at the University of Sydney Dr Gordon Rogers is the joint leader of a new levy funded



project that will help the mushroom industry identify key research directions and ensure the Mushroom Research Unit continues as a world class research facility.

The project will be delivered jointly by the University of Sydney and Applied Horticultural Research (AHR) and has the following key aims:

- Drive innovation in the mushroom industry with research-based solutions
- Direct activities of the Mushroom Research Unit at the University of Sydney
- Identify and test sustainable best practice
- Encourage new expertise in the industry through R&D.

A new diagnostic tool to help growers control disease

Dr Rogers will also update conference delegates on the levy-funded project (MU12007). The project has

delivered a commercially available early disease detection service which has revolutionised the way growers manage disease. Growers can identify disease early, whether in compost, grow room, or the crop itself, facilitating timely action to manage diseases and minimise losses.

The PCR test used to detect diseases uses the same technology as the gold standard PCR test for detecting COVID-19. This method can reliably identify *Trichoderma* (*Trichoderma aggressivum*), Dry Bubble (*Lecanicillium fungicola*), Cobweb (*Cladobotryum* sp.) and Bacterial Blotch. All four diseases are included in the same testing 'panel' so only one sample is required.

Dr Rogers' focus is on extension and research, and his passion is for communicating the results of research to producers and end-users in a way that helps them implement research results profitably and sustainably.

FULL LIST OF LEVY INVESTMENT R&D UPDATES

Speaker	Presentation
Brett Fifield, CEO, Hort Innovation	Hort Innovation update
Mark Spees, Industry Strategic Partner	Hort Innovation investment update
Jane Smith & Kylie Hudson, General Managers of Marketing, Hort Innovation	Australian mushrooms marketing update
Leah Bramich, Relationship and General Manager, AMGA	AMGA update
Natasha Greenwood, General Manager WA/SA/NT, Regional and Agribusiness, Commonwealth Bank	Economic update
Dr Flávia Fayet-Moore, Nutrition Research Australia	Educating the food industry about the nutritional benefits of Australian mushrooms
Dr Damien Belobrajdic, CSIRO	Mushrooms and their potential health benefits in lowering blood cholesterol
Dr Jenny Ekman, Applied Horticultural Research	Food safety, quality, and risk management
Dr Michael Kertesz, The University of Sydney	Developing a database of bio-markers for compost quality control to maximise mushroom production yield and, Optimising nitrogen transformations in mushroom production
Dr Warwick Gill, University of Tasmania and Judy Allen	Pest and disease management approach for the Australian Mushroom Industry
Dr Gordon Rogers, Applied Horticultural Research	Marsh Lawson Mushroom Research Centre Update

The full conference program, including details on the social events and farm tours is available on the AMGA conference website: <https://amgaconference.com.au>