# MushroomLink

SUMMER 2022 ISSUE 3


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# MushroomLink

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## Did you know there is more to The MushroomLink project than this magazine?

- The best way to keep up to date with MushroomLink is to subscribe to the monthly bulletin. Scan the QR code below to sign up.
- Our website contains factsheets, case studies, videos, webinars and podcasts.

MushroomLink is for composters, growers, pickers, and everyone in-between.

If you have a suggestion for something you would like to see, or some feedback on how the project has been going please let us know at admin@ahr.com.au

We look forward to continuing to work with all members of the mushroom supply chain, delivering information the industry wants, the way the industry wants it.

*(MU21003: Mushroom industry communications program) is a Hort Innovation mushroom fund project.*
*It is funded through the mushroom levy and contributions from the Australian government. Applied Horticultural Research (AHR) is the key research provider for this project.*

# Highlights






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**Cover:** *An immaculate harvest at SA Mushrooms, visited during the AMGA Conference. Photo by J. Ekman*


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# Contents

# DEVELOPMENTS IN MUSHROOM HARVESTING

**Of all horticultural industries, mushroom cultivation is the most tightly controlled. Mushroom growers are not at the mercy of the weather, crop cycles are quick, and everything from moisture to atmosphere to temperature can be tweaked to optimise quality and yield.**

**Paulette Baumgartl and Dr Jenny Ekman report from the AMGA Conference in Adelaide**

Human resources are, however, less predictable. Worldwide, businesses are facing staff shortages, and this is felt particularly in the Australian horticultural industry. Availability of staff is impacted by low unemployment and a post-COVID shortage of seasonal workers. Added to this is a general reluctance to do work which may be physically demanding or uncomfortable. All these factors combined can develop into a perfect storm, leaving beds of unharvested mushrooms in its wake.

One thing growers can control is to create good working conditions that encourage staff retention. Installing ergonomic systems, incorporating technology, and 'back to basics' human resource management, are some of the tools at a grower's disposal.

But what does this look like, how much will it cost and how can it be implemented?

Lucky for the industry, a perfectly curated session at the recent AMGA conference brought together three experts from the Netherlands who showcased their solutions to this problem. These ranged from a system that could be fully automated in the future, to using technology to optimise picking efficiency, and applying considered HR management and training to increase the speed, comfort, and well-being of workers.

# THE AUTOMATED DRAWER SYSTEM

Roland van Doremaele from the Christiaens Group provided an amazing vision of what the future of mushroom cultivation could look like.

Roland has been visiting Australia for a long time. His first visit was as an intern, while still at university. He understands our local industry well and believes that robotic technologies have a lot to offer.

## Separating pinning from harvesting

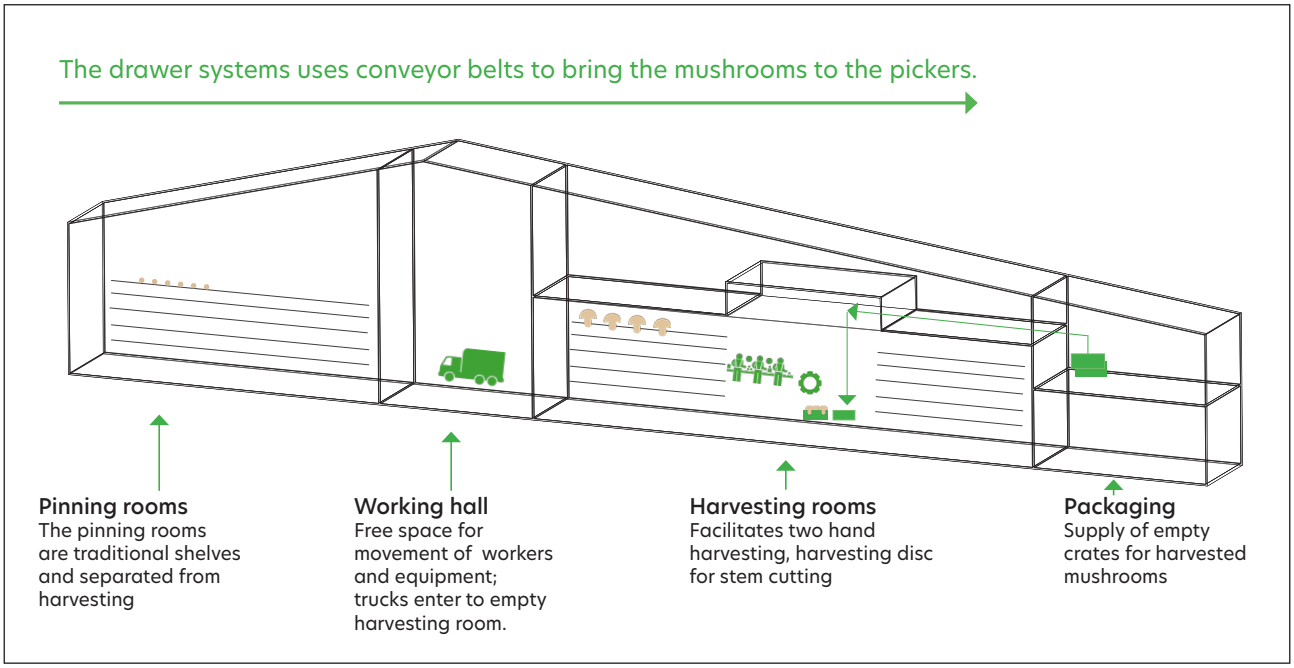
Separating pinning from harvesting has some immediate advantages, notably hygiene and disease prevention. As the pinning stage is more sensitive, keeping that closed off from workers and general farm traffic makes good sense. Moreover, as no one needs to access the mushrooms, the shelves can be more tightly packed in a smaller space – the epitome of vertical farming. Optimised air flow ensures circulation around the closely stacked shelves.

From an investment perspective, the pinning room is simple, with the new technology concentrated in only half of the rooms. This also means that once the mushroom-filled drawers have left, the rooms can be cleaned and cooked out with no concern about ruining delicate and expensive machinery.

## What's new in picking?

When it comes to harvesting, the Christiaens group supply two systems - the drawer system and tilting shelves. In simple terms, in the tilting system the picker goes to the mushrooms, whereas in the drawer system the mushrooms go to the picker.

At the conference, the focus of Roland's presentation was the drawer system. This has been in development for 10 years and uses robots to both help pickers, and partly replace pickers. One of the stand out features of the drawer system is the mesh conveyor belt, which




Simple cross section of a draw system farm, with pinning and harvesting separated. A working hall provides each access for equipment to move product.

Roland van Doremaele at the AMGA conference

Pickers at the harvesting wheel

The conveyer belt moving the shelves

moves the mushrooms from the pinning room to a harvesting room, bringing the mushrooms to the workers on a series of belts.

## How does this all work in practice?

Once the pinning room is filled with compost and casing, the cycle starts. It takes approximately two weeks for the first flush to commence. The nets are then pulled into a drawer onto a conveyor belt and sent on their way to the picking area.

On-farm studies have shown that this movement does not adversely influence growth, but actually has some benefit. Disrupting the mycelia seems to promote growth, perhaps due to the extra aeration, creating an energy boost that triggers the mycelium to heal, regrow and reconnect. There is also a suggestion that cracking the mycelium spreads the pins.

The shelves in the harvesting rooms move underneath the pickers. As a single shelf is presented, the pickers can stand up straight, and more easily see which mushrooms are ready for picking. They stand on either side of the shelf, loading mushrooms onto a harvesting disc. The disc rotates, the stems are cut, and mushrooms fall into crates. As pickers are not cutting stems they can use both hands to simply harvest mushrooms, greatly improving speed and efficiency.

A third member of the harvest crew packs the mushrooms into punnets or boxes. When the minimum weight is reached the box is transported on a conveyor that takes the filled boxes or punnets to a separate packing area at the end of the shed. Here they can be wrapped, lidded, and palletised.

The open harvesting area is well lit, making it easier for pickers to see the mushrooms. Furthermore, as the mushrooms come to the pickers (instead of the pickers needing to move) more time is saved, making it easier to do multiple picks over a bed, sometimes up to five in a day. Pickers can focus on the larger mushrooms only, spending less time on sizing.

Picking crews like having a larger, well-lit space to operate, as well as being part of a three-person team who can easily communicate as they work. Good for workers, good for productivity.

## And efficiency?

The system has been developed with a focus on low maintenance. As futuristic as it sounds, the actual technology used has been intentionally minimised.

Efficiencies are won via the two-handed picking and multiple passes through the beds, not possible in traditional harvesting rooms.

The system also takes clever advantage of the fast-growing rate of a mushroom. The shelves move up and down, starting at the bottom shelf and picking larger mushrooms, before moving upwards. The first cycle takes 2-3 hours; the pickers then return to the bottom shelf and starts again, by which time the remaining mushrooms have increased in size by 8 to 12%.

That's a lot of mushrooms picked in a shorter time.

The system has been designed for future incorporation of a robotic picker. This could be used simply for thinning or even for end harvest.

However, the real magic here is the use of technology to help and optimise pickers, rather than replace pickers. Fewer staff can pick more mushrooms, and retaining these staff is easier when working conditions are optimised for their well-being.

### What about smart farming integration?

Big data is the buzz word de jour, but there is a good reason for that. With a little thought, the integration of cameras and other monitoring equipment can greatly improve efficiencies on the farm. With sensors, data loggers and scanners, the growing rooms can become smart farms, detecting disease early and facilitating ongoing tweaks and improvements of the system.

Clean energy technology can also be integrated easily.

Other additions include the automatic cleaning after emptying and automated watering between flushes.

Already three drawer system farms are up and running in Manchester (UK), Vancouver (Canada) and one in the Netherlands.

Roland is excited about the future and believes that a harvesting robot which combines the Internet of Things with artificial intelligence is the next step, reducing labour even further and telling you what to pick and when.

### So, what does this all cost?

The drawer system is something to consider for new growing rooms with the estimated cost to be about 30% more compared to a traditional farm.

The return on investment obviously depends on many external factors. However, the Christiaens Group estimates it should be around three years. This return is not based on harvest efficiency alone. Results from existing drawer farms show that there is also a 10% increase in production from the same volume of raw materials.

We look forward to following the future developments of the drawer system.

### key points of the drawer system:

- Separation of growing and harvesting rooms
- Mushrooms develop in a smaller and more tightly packed vertical space
- Nets containing the compost, casing and substrate are moved to the harvesting room via a conveyor belt
- Two handed picking and automated stem cutting halves the pickers required, with a harvest team comprising 3 people instead of 7 or 8
- Approximately 60-70 picks/minute per picker
- Pickers cover each shelf multiple times in a day, taking advantage of the rapid growing rate of mushrooms
- Bed comes to picker, not picker to bed
- Generally, not suitable for existing farms
- Big data will have a significant role to play to ensure more evidence (data)-based on farm decisions
- Robots will never pick 100% of mushrooms, but technology can make human workers both more efficient and more comfortable

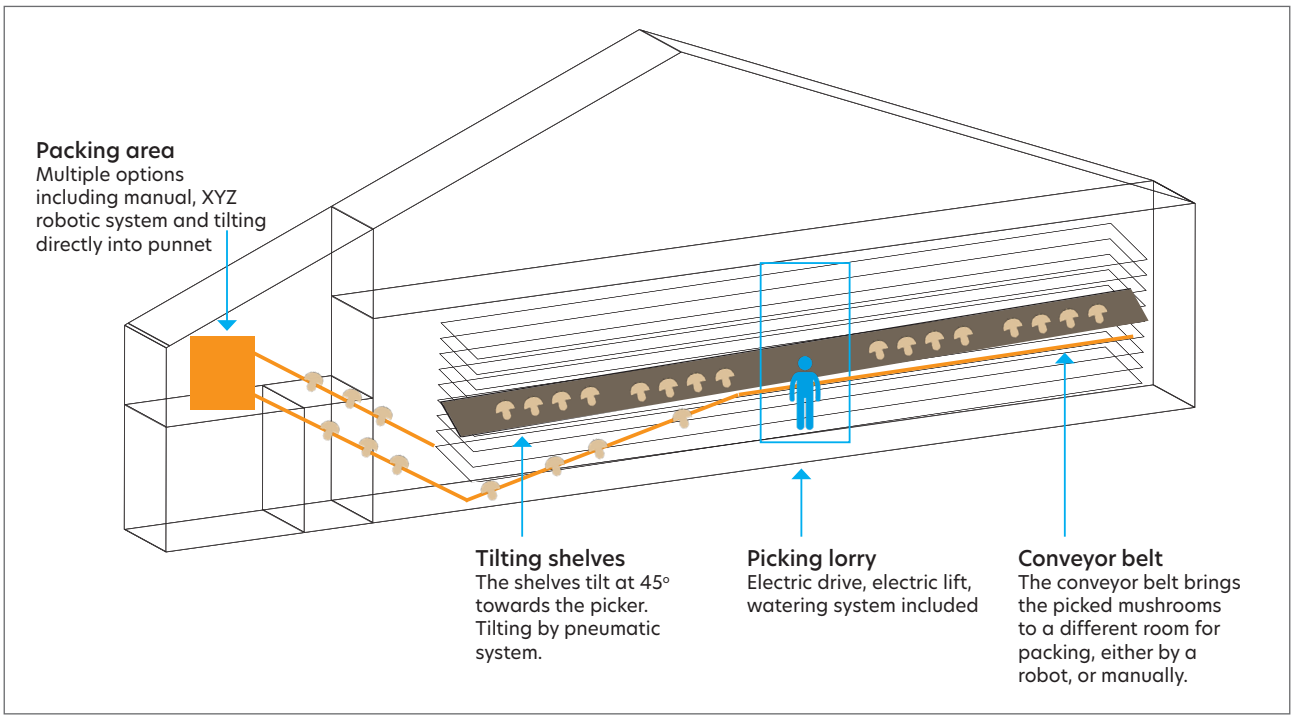
# THE TILTING SHELF SYSTEM

Jack Lemmen from GTL Europe has been tinkering away at a solution to the challenges of mushroom harvesting for 30 years. The result is an innovative system of tilting shelves that are picker friendly and facilitate two-handed picking, which increases efficiency by more than 20%. When combined with automated sorting and packing, efficiency goes up by an astonishing 60% or more.

Like the Christiaens Group system, GTL Europe also sometimes separates growth and pinning from harvesting operations. However, Jack made the point that this separation is based on a 14-day cycle with two flushes, so may be less relevant in the Australian context where three flushes are common.

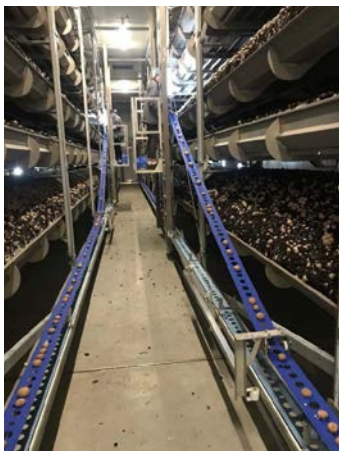
Regardless of this, harvesting is separated from packing, creating a number of efficiencies in operation.


Jack Lemmen at the AMGA conference




Simple cross section of a titled shelf system, with harvesting and packing separated. Mushrooms are moved via conveyor belt to a packing area.





Picking with two hands changes the orientation of the body to face the shelves at 180 degrees.

## What's new and how does it work?

The tilting shelf system is all about making it as easy as possible to pick with two hands.

Shelves, controlled pneumatically, can tilt 45 degrees with no disruption to the casing or compost. By tilting the shelves, many challenges of mushroom picking disappear. No leaning over wide beds, no sore back, no straining while trying to reach the 1400mm width, no missing mushrooms hiding in the centre of the shelf.

The mushrooms are more clearly visible to the picker, who can look at them directly instead of at an angle. When combined with improved ergonomics, picking becomes easier, more comfortable and more accurate.

But the improvements do not stop there. Coupled with the tilted shelf is a thin belt which conveys the picked mushrooms away and up to the second level ready for packaging. As the belt sits below the shelf, a picker is placing products downwards, not lifting. Although mushrooms are not heavy, the repetitive action of lifting thousands of mushrooms per day cumulates to a significant strain.

The second aspect of the system is to take the packing away from the harvesting room. This allows concentration of packing technology on a second floor (or other part of the shed). Another advantage is the reduced risk of contamination as there are fewer people in the harvesting room.

Packing robot on the second floor

## Is automatic packing realistic?

The answer is an emphatic yes!

Another exciting development is the early results achieved by the packing robot. Currently, for every two pickers in the harvesting room, there are two packers waiting on the second floor.

The packing robot has the task of placing the correct weight in multiple types of punnets, presented cap upwards. A prototype has been developed which can deal with different size grades in different punnets.

With the capacity to handle 12 mushrooms in 3-4 seconds, the robotic packer is four times faster than a human packer. This means one robot can keep up with two pickers sorting two sizes of mushrooms.

While robotic picking remains elusive, due to the anatomy and growing form of mushrooms, robotic packing is here and impressive.


Sorting and packing robot with belt for moving picked mushrooms

### What about efficiency?

As with the drawer system, two handed picking also underpins the genius of the tilting shelves, which improves efficiency by 20% or more just by using two hands instead of one.

However, it is the addition of the robot packer where it really starts to be game changing. When combined with the tilting shelves system, this could potentially achieve efficiency gains of at least 60%.

### Anything else?

Glad you asked. Another novel addition to a mushroom farm is the pointing system. While not yet available, this simple light projection system is mounted on the picking trolley. It scans the diameter of the mushroom on the shelf, and projects either a red or green light, highlighting which mushrooms are ready for picking.

It can also take photos and analyse mushrooms on several criteria, facilitating quick feedback to the picker, including speed of picking and size assessments.

The best news is that this device can be installed on regular picking trolleys as a retrofit.

Again, this system makes it easier for the picker to know which mushrooms to harvest now, and which to leave for later. Trialled on a commercial farm, the picker didn't want to give the device back, as it made their job so much easier.

No longer a theoretical concept, tilting shelves and packing robots are real and viable technologies. We

## Key points of the tilted shelves system:

- Tilted shelves are ergonomic, reducing back strain
- The tilting system plus conveyor enables picking with two hands instead of one
- Tilting shelves improve visibility, making it easier to decide what to pick
- A conveyer belt sits below the shelf, taking mushrooms to the packing area
- Pickers place mushrooms down, rather than up, reducing arm strain
- Mushrooms are taken to a separate room for trimming and packing, either manually or automated
- Reducing the number of staff in harvesting rooms improves hygiene and decreases risk of disease
- With manual packing, efficiency increases by more than 20%
- With automatic packing, efficiency could increase by more than 60%
- A pointing system will soon be available, beaming coloured light onto the mushrooms ready for picking.

## Back to basics -

# BEST PRACTICE IN TRADITIONAL GROWING ROOMS

look forward to reporting about their impact on farms in future editions of this magazine.

Brigitte Hendrix grew up on a mushroom farm. She really knows mushrooms, having picked her fair share and supervised the picking of even more.

In her presentation, Brigitte reminded us there is success to be had in taking care of small everyday details.

Picking mushrooms is a whole lot more than putting pickers in a room. Important issues need to be considered, including good planning and scheduling, clear communication, and proper training.

While bonuses are an important way to motivate workers, managing schedules, providing training, and having clear expectations can combine to create a happy, productive and stable workforce.

### Organising and planning

As simple as it sounds, letting employees know your expectations for the week is vital.

A plan can could include the kilograms expected in a week, number of pickers needed in each room each day, and where each picker should be.

In her presentation, Brigitte provided an example of weekly and daily plans (Tables 1 and 2). A good plan will also provide the grower with a clear overview of what can be expected on a farm in any given week. Bad planning results in lost yield, reduced quality, disappointed customers, and dissatisfied workers.

| | Estimated production (kg) | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Room | Mon | Tue | Wed | Thur | Fri | Sat | Sun | |
| 1 | 250 | 1250 | 1500 | 1700 | 450 | | | 5150 |
| 2 | | 200 | 1000 | 1550 | 1750 | 500 | | 5000 |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | 50 | 300 | 1250 | 1250 | 2850 |
| 6 | | | 75 | 200 | 1250 | 1500 | 150 | 3175 |
| **total** | **250** | | **2575** | **3500** | **3750** | **3250** | **1400** | **16175** |

**Table 1.** Weekly plan (example)

At the beginning of a harvest cycle, supervisors should pay particular attention to avoid damage to the mushrooms. For example:

### Day 1

- Thinning out to create space and promote better quality of mushrooms
- Carefully supervise pickers at this stage to prevent damage

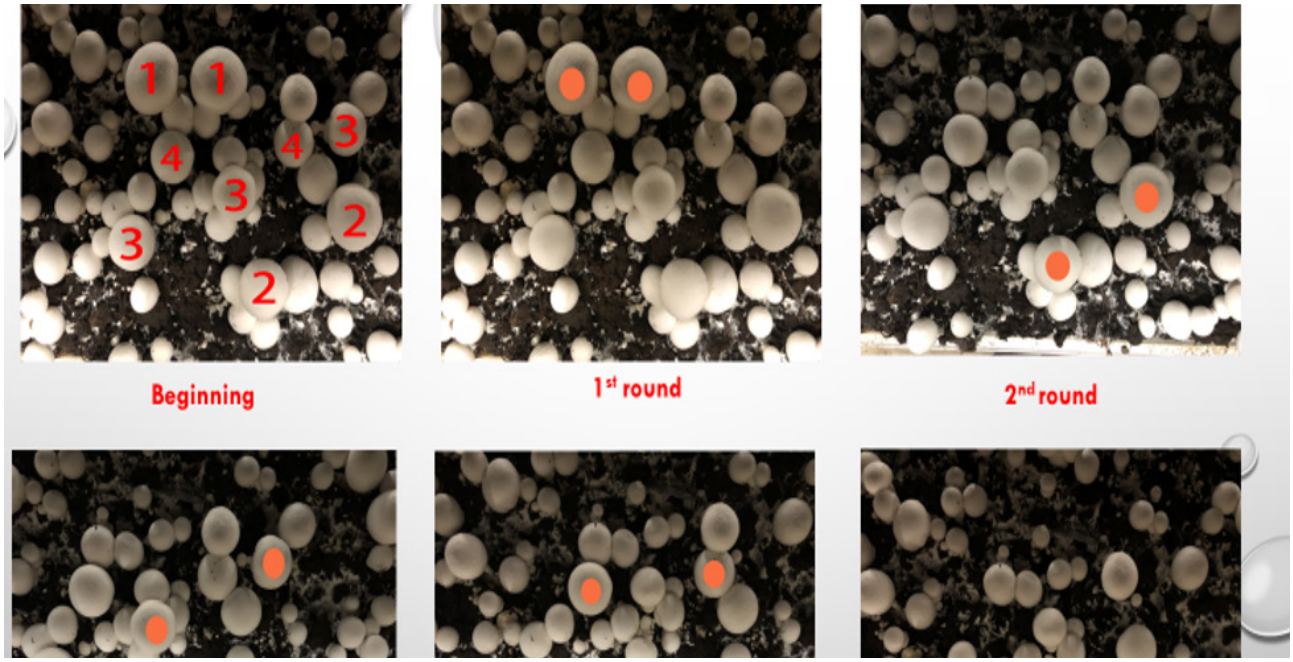
### Day 2

- If thinned out correctly on day 1, look on day 2 if further thinning is needed or if picking can begin
- Take a good look at the room, evaluate what you need and clearly communicate this to pickers
- Try to pick a room several times

### Clear communication and instructions

Any efforts put into planning will only be effective if they are clearly and regularly communicated. Use signage to be clear about which sizes to pick, which packaging to use and what sort of volume is expetced to be picked by the end of the day.

Systematic picking, correct position of the body, and how to cut need to be part of the training process. Brigitte emphasised that pickers need a little time to get this right, and cannot be expected to master it on day




| room | large | medium | small | 2nds | total | Kg/hr | hours | Pickers needed | Pickers planned |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 300 | 700 | 100 | 50 | 1150 | 32 | 35 | 4.4 | 4 |
| 2 | 700 | 250 | | 50 | 1000 | 37 | 23 | 3.3 | 4 |
| 3 | | 150 | 300 | | 450 | 15 | 23 | 3.75 | 4 |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| **total** | **1000** | **1100** | **400** | **100** | **2600** | | **81** | **11.5** | **12** |
| | | | | | | | | | |
| Date | | | | Remarks | | | | | |

**Table 2.** Daily plan (example)

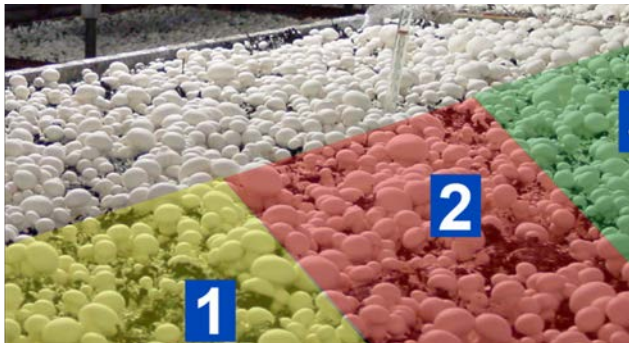
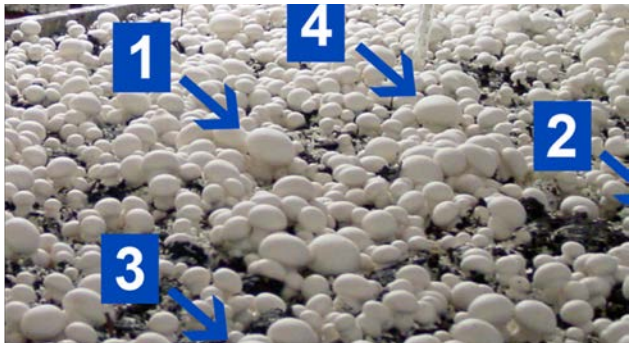
1. Patience and persistence are required when training new staff. The time investment pays for itself.

Multiple studies have shown that after 7 hours, pick rates decline from fatuigue. For optimal efficiency, get the most out of a standard 8-hour day rather than extended shifts of 12 hours.

The best thing about Brigitte's systematic method of organising staff on a mushroom farm is that it can be implemented right away.

As in any workplace, good HR management, where expectation are clear, creates a workplace with less stress, more motivation and therefore happier workers.

## Dos and don'ts of picking

| CORRECT | INCORRECT |
| --- | --- |
|   |   |
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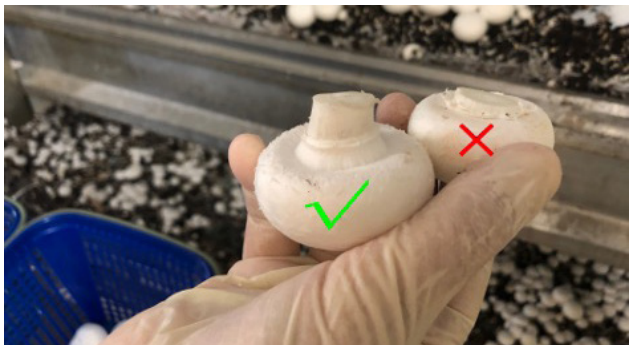
|  | |

Hort Innovation Strategic levy investment | MUSHROOM FUND

This project has been funded by Hort Innovation using the mushroom research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

International speakers were invited to present at the AMGA conference *Growing the Future Together* with support of the Hort Innovation Mushroom Fund

## Key points on back to basics

- Train pickers on thinning out, picking rate, care of the product
- Maintain good supervision, show them how to pick a room
- Plan and be organised
- Communicate your plans and provide clear instructions daily in each room
- Review plans and adjust when need.
- Train pickers in the three-mushroom method, to increase efficiency (look out for a MushroomLink how to video coming soon)

Contact Brigitte for more information:

info@musharco.com

# INSIDE THE MARSH LAWSON MUSHROOM RESEARCH CENTRE

**By Paulette Baumgartl**

**Research and development underpin new technology. For the mushroom industry this is no different. A dedicated research centre is one driver of important developments, as industry seeks ways to adapt and respond to challenges.**

Research is a systematic mechanism by which we can answer questions and understand processes. Data and discovery facilitate an evidence-based approach to solving problems. Research can optimise processes on farms, ultimately improving both their economic and environmental bottom lines.

The Australian mushroom industry has long enjoyed a fruitful relationship with researchers. Systems and processes directing current mushroom growing practice are based on efforts from past research, including studies into compost, pest and disease control, and harvest and post-harvest technology.

In this context, it is welcome news when universities and industry collaborate. This is exemplified by the Marsh Lawson Mushroom Research Centre (MLMRC), situated within The University of Sydney.

Dr Gordon Rogers, Director of Applied Horticultural Research, reminded the mushroom community of this unique facility at the AMGA conference, highlighting its capacity to support growers and the industry as a whole.

The aim of the centre is to contribute to a strong research capacity for the Australian mushroom industry and operate a world class research unit.

"The centre provides research leadership, engages with global leaders in mushroom research, and communicates its findings," Dr Rogers said.

As issues are similar around the world, Dr Rogers believes it makes sense to engage with global researchers and include international members on the steering committee.

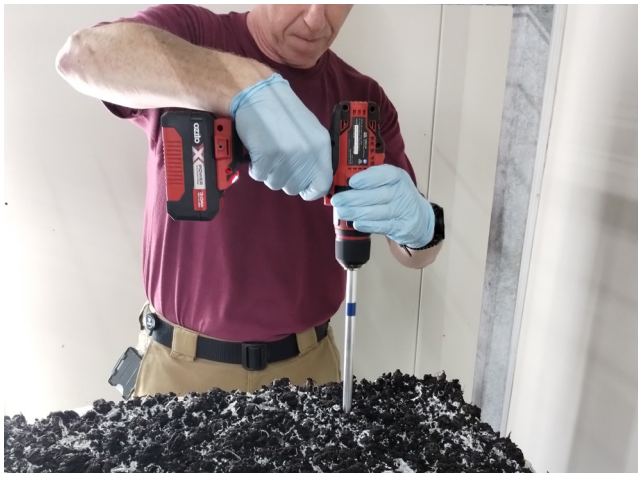
"We plan to pursue international research collaborations, including students. This will help us become more involved in the International Society for Mushroom Science," he said.

Activities at the MLMRC are guided by a steering committee, which includes researchers, growers, and composters. This group approves and prioritises activities, as well as identifying and directing research at the centre.

## The unit itself

The unit has existed in one form or another for 30 years. It was originally a simple growing facility in a building basement. Its has been in its current form for the last 10. Located within the grounds of the University of Sydney, it has two growing rooms, each with a 72- block capacity and full environmental controls including a boiler for cookout; it is an ideal testing facility for industry.

Drip irrigation trial before (left) and after (right) casing



Dr Phil Butterworth collecting a sample of compost + casing

Sandra Evangelista and Tyler Kristensen assess dry bubble

Adjacent to the growing rooms is a well-equipped laboratory, with sample storage freezers.

Two trained growers (AHR agricultural scientist Umberto Calvo and PhD student Sandra Evangelista), supervised by Tim Adlington (Steering Committee Chair), currently operate the facility.

The University of Sydney has provided ongoing support to the unit with maintenance, new equipment and running costs, including a new boiler, humidifiers, and an overhaul of the cooling system.

"The industry is well-supported by the university, and we are lucky to have this ongoing assistance," Dr Rogers said.

The growing rooms are well maintained and highly climate controlled, with PCR testing between crops ensuring cleanliness and other commercial standards are upheld.

"While not a farm, the unit is similar enough to a growing room to conduct trials with a fair amount of confidence that on-farm conditions are being simulated," Dr Rogers emphasised.

"It is there for the industry, and we want more people to know about it."

## Previous studies

Traditionally, the unit has been used for pesticide registration efficacy studies to support permit applications. In the last five years, 37 trials have been conducted in the unit, including the successful permit application of Vivando® based on efficacy and residue trials.

Other highlights include:

- PCR disease diagnostic project (MU12007)
- Casing replacement and improvement trials
- Alternative nitrogen sources research
- Investigations into cold plasma treated irrigation water

- Compost supplementation trials
- Impact of calcium on mushroom whiteness trials
- Impact of $CO_2$ concentration on flush timing, yield and quality

## Current and planned trials

Collaborations are currently underway with researchers from around Australia. These include digitally monitoring compost moisture, evaluation of nitrogen forms under the casing layer, and the novel work of Dr Kertesz that is investigating nutrient seeding and its potential to fortify the nutritional value of mushrooms.

Dr Kertesz's team is also evaluating the impact of different substrates on microbial populations during the spawn run.

The *Pest and Disease project* team Judy Allan and Warwick Gill run regular spot sanitiser treatment trials in the unit, and a further project is working to establish threshold levels of potential compost contaminants (e.g., pesticide residues) that find their way into the edible part of the mushrooms.

The unit will also soon welcome Dr Aimee McKinnon from Agriculture Victoria as she commences evaluations into non-synthetic (biological) controls for the mushroom industry.

## Transitioning to a new facility

The current unit is situated on prime university real estate in the middle of the univertsity's inner city campus and, unsurprisingly, is under some pressure.

A move would provide an opportunity to grow and modernise the facility, with current plans including four growing rooms with a 5-tonne capacity, fitted out with Dutch shelves, a rack system, and an industry standard environmental control system.

A new site, potentially further out of the city towards the new Western Sydney Airport Precinct, could also host a compost research facility to research Phase I, II and III compost.

The world standard design would include Phase I bunkers and Phase II/III tunnels, with full pasteurisation spawn run facilities including heating elements in the walls of the Phase II/III tunnels to maintain temperature.

Dr Ralph Noble discussing trials with Meghann Thai and student Juno Bennet.

The unit currently sits on prime real estate in the middle of The University of Sydney's  main Darlington campus

## Get involved

The Marsh Lawson Mushroom Research Unit is available to the industry for research projects and small proof-of-concept trials.

The team of researchers and technicians can tailor support packages to your needs, including trial designs, growing and harvesting, treatment applications, data collection, analytical services, and reporting.

For more information contact Umberto Calvo (umberto.calvo@ahr.com.au) or Adam Goldwater (adam.goldwater@ahr.com.au)

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# ALTERNATIVE CASINGS AND A SUSTAINABLE MUSHROOM INDUSTRY

**Mushrooms are a low impact food. As vertical farms, their land footprint is small, and energy and water inputs into mushroom crops are much lower than comparable foods. Consequently, mushrooms have an excellent $CO_2$eq rating. By Dr Jenny Ekman and Paulette Baumgartl**

This 'green' image, coupled with great taste and an ever-growing list of health benefits, weaves a sweet narrative of mushrooms as a sustainable food source for a growing world population. There is just one little snag.

Casing, or more specifically, peat casing.

Peat extraction, its history, ecology, the debate around sustainability, and its application in the horticultural industry could fill pages. What is relevant is that the UK, Ireland and Germany, major peat suppliers, are considering phasing out peat extraction. And although there is currently sufficient supply of peat for the horticultural industry, sustainable alternatives are needed to future proof the mushroom industry.

As a country without peat extraction, Australian growers have relied on expensive imports from Europe. Development of an alternative casing from local materials would potentially save cost, avoid shipping delays, and enhance the sustainability of the mushroom industry.

Presentations at the AMGA conference from Folkert Moll (Kekkilä BVB) and Dr Ralph Noble (Microbiotech Ltd) showcased the latest developments in Europe, where much of his research is occurring.

# KEY SUSTAINABILITY TRENDS IMPACTING THE INDUSTRY

The mushroom industry is not immune to global events, whether they be social, economic, or environmental. Wholesalers and retailers are acutely aware of the impact of sustainability on brand values and scrutinise supply chains accordingly.

Provenance claims, whether a diamond, a bottle of wine, or a mushroom, no longer start and end with location; the full supply chain is part of the story, including any raw materials, used in production.

So where do you start? Folkert Moll, the sustainability manager at Kekkilä BVB, brought all this it into clear context for the mushroom industry. To navigate a path to sustainable casing, his company is looking to the UN Sustainable Development Goals[1] as a guide. Six key development goals impact the mushroom industry particularly, namely urbanisation, climate destabilisation, ecosystem decline, food crisis, inequality, and resource scarcity.

Resource scarcity is the immediate focus, including:

- Availability of local and circular raw materials
- Competition with other substrates and industries
- Quality of available raw materials and processing needs
- Upscaling from research to commercial application

## So, what makes a good casing material?

The holy grail of an alternative casing, simply put, is a material that is as good as peat but with a lower environmental footprint. Each raw material has pros and cons, and chemical, physical, and biological properties need to be well understood. Further, these properties can change when materials are mixed.


Specific characteristics include:

- high-water holding capacity
- low salt content
- hostile to moulds
- low cost
- readily and reliably available locally
- does not stick to mushrooms
- no pathogens or contaminants
- does not attract flies

## New solutions

According to Wageningen University[2] in the Netherlands, the volume of growing media will need to increase by 332% over the next 30 years to meet the food demands of a growing world population.

By 2050 the amount of new raw materials (not yet commercially in use) has to equal the total amount of raw materials currently used for growing media. This already huge challenge is compounded by the competition for resources from other industries.

Demand for peat will likely double, although this largely depends on the political trade-off between the role of peat in enabling food safety and security, and the environmental impact of extraction. It is important to note that as horticultural peat extraction accounts for only 0.05% of global peatland use, and restoration efforts often add value to otherwise degraded peat ecosystems, the environmental impact is small.

Nevertheless, to ensure a sustainable and prosperous mushroom industry, the development of alternative casings is an industry priority.

One such group that has taken on this challenge is the European consortium BIOSCHAMP (https://bioschamp.eu), a collaboration of six countries to research, mix and test new circular raw materials and biostimulants that can improve sustainability, while ensuring the safety and effectiveness of mushroom growing.

The consortium aims to create novel casing soils using new materials with key qualities that include appropriate gas exchange, myceleium protection, excellent water holding capacity, nutrient holding

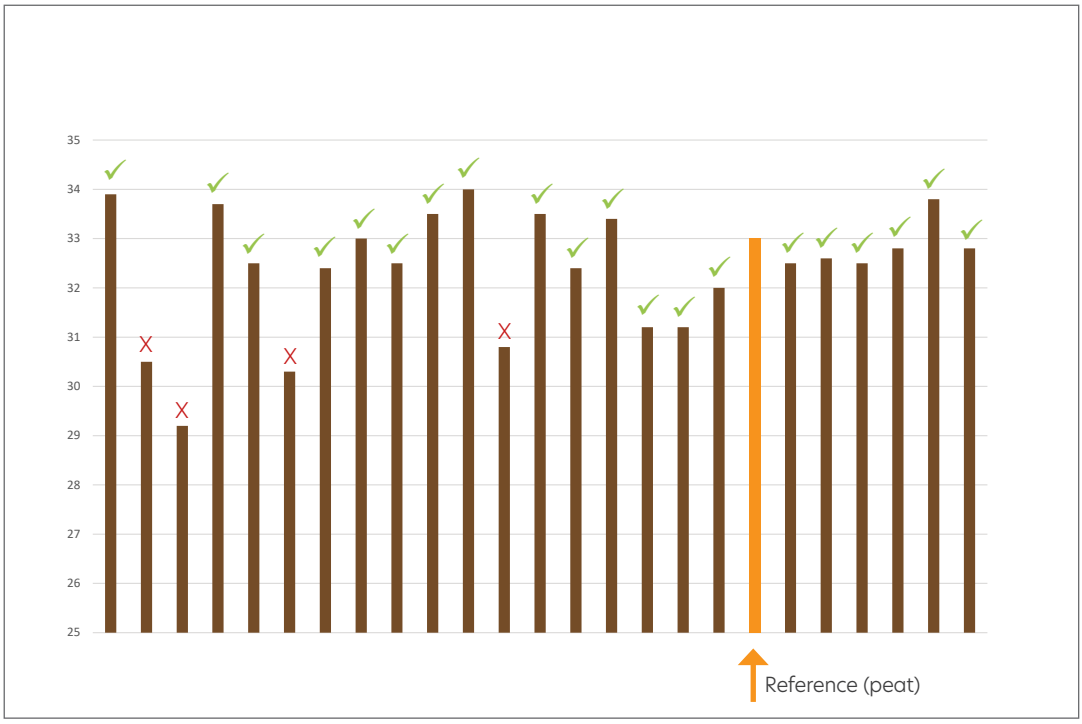



**Figure 1.** Yields obtained using alternative casing materials (kg/m²), X denotes materials where yield was reduced; most materials tested were not statistically significantly different to peat, marked with ✓.

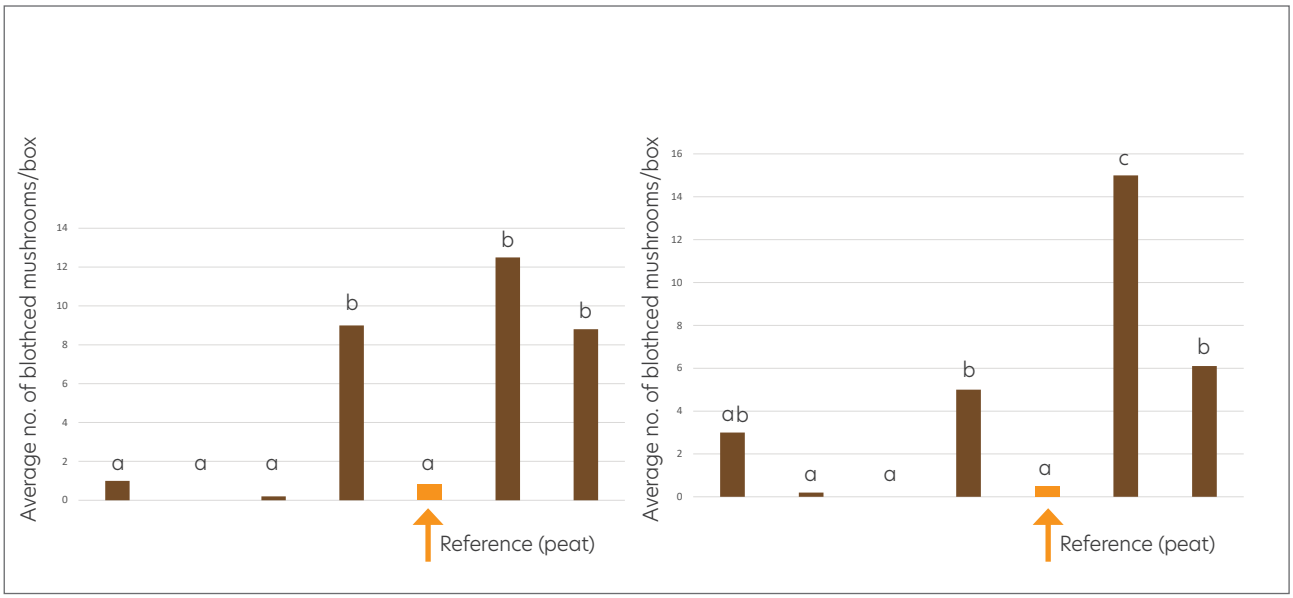



**Figure 2.** Bacterial blotch measured in average number of blotched mushrooms/box. Materials marked with 'a' are not significantly different to peat.

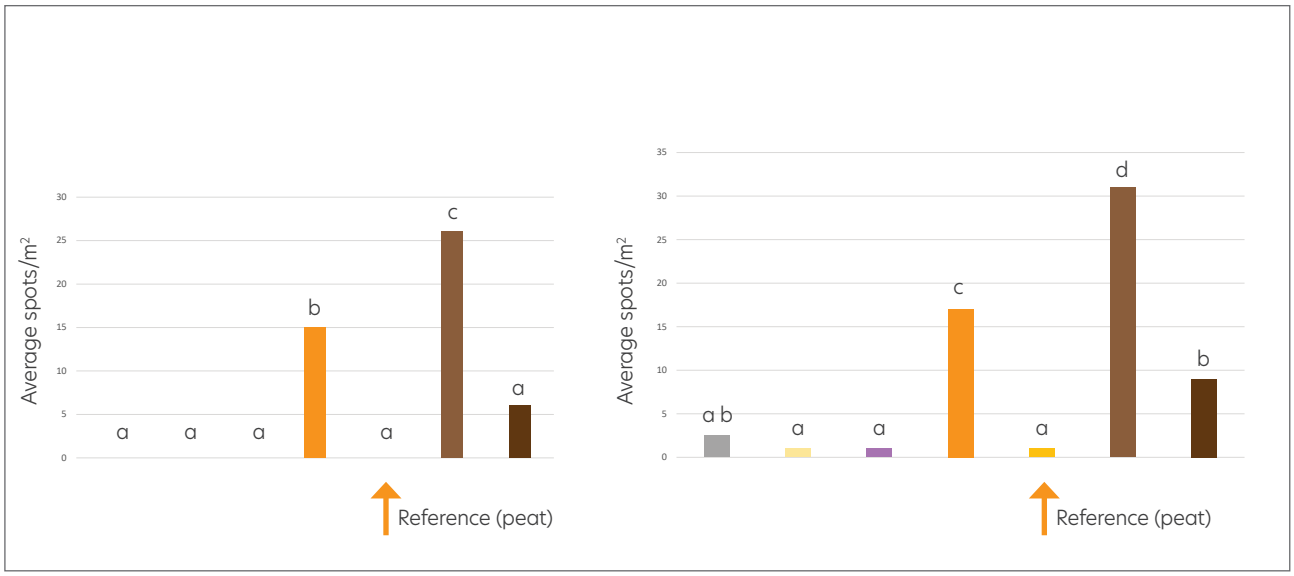



**Figure 3.** Green mould measured in average spots/m². Materials marked with 'a' are promising.

capacity and are free from pests and pathogens. It also needs have suitable physical properties, including a structure that supports and protects the expanding mycelia without being a barrier to growth.

"We (Kekkilä-BVB) joined as a project partner two years ago with a goal to create a more sustainable casing soil, reducing the sector's dependency on peat," Folkert said.

While the research is still at the trial stage, preliminary results are promising. In Figure 1 materials are not identified, but those marked with '✓' provided results statistically similar to the reference peat.

"By 2024 we will be able to discuss the alternatives in more detail, but in the meantime, I feel very optimistic that a solution is not far away," Folkert said.

The materials were also assessed for their effects on disease, specifically number of mushrooms with bacterial blotch and occurrence of visible *Trichoderma*. Several materials performed as well as peat on both counts (Figures 2 and 3). Combining these results with yield data reveals several materials worth taking to the next stage of testing.

## What's happening in the meantime?

While researchers toil away finding a fit for purpose peat replacement, peat will continue to be the major constituent of mushroom casing. Kekkilä-BVB are committed to the best possible practice (following Responsible Peat Production guidelines) in the sourcing, extracting, and rehabilitation of peat landscapes. which are extremely high in Sweden and Finland, where most of the peat is sourced.

# UNDERSTANDING MICROENVIRONMENTS **TO CHOOSE THE RIGHT ALTERNATIVE CASINGS**

Is blending peat with something else the answer? Probably not, says Dr Ralph Noble, who has been researching the microbiology of mushroom cultivation for over 40 years. Dr Noble has turned his attention to how understanding the microenvironment of casing can help us achieve net-zero, peat-free mushroom farming.

Dr Noble's presentation focused on the properties of casing and factors that impact yield, quality, and disease.

## Some background

Researchers have been searching for alternatives to peat for many years.

Dried milled peat was used in Australia up until the early 1990s, when wet dug peat became more readily available. Although the wet dug peat is bulkier and heavier, its superior water holding capacity meant it quickly became the preferred material. This is because it retains the porous structure of the *Sphagnum* moss from which it was formed.

Other countries are already trying to reduce use of peat, either due to cost or from necessity. For example, France and Spain commonly mix clay from local soils with peat, while China still uses milled peat, sometimes combined with rice husks and river mud.

However, it is hard to beat peat. South Africa has minimal sources of peat locally, and those it does have are protected from extraction. During the years of apartheid, sanctions made it impossible to purchase peat externally. Local research developed and commercialised a product based on sugar cane bagasse. While this was widely used, the end of restrictions has seen farms return to the best possible casing material –wet dug moss peat.


Many options have been investigated, each with their own pros and cons, as illustrated in Figure 4 (break out box on pages 26-28).

## What has the science said?

If science is the process of asking nature a question, then data is her answer.

Luckily for the mushroom industry, Dr Noble has been asking the right questions and has collated some useful data to answer the original question: What works and why.

When considering yield alone, peat mixed with up to 25% other materials often looks promising. Unfortunately, yield often declines as the non-peat portion increases past this level.

Some of Dr Noble's data is shown in Figure 5. In these trials, only recycled rockwool and bark plus green waste compost could be added to peat as 25% of the total volume without negatively affecting yield.

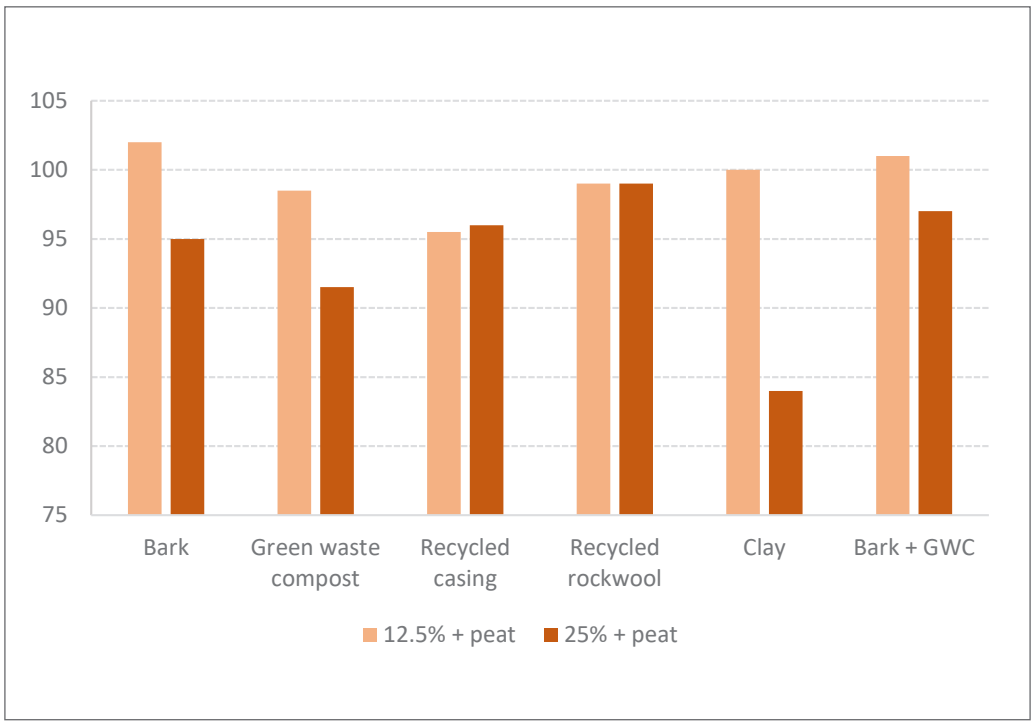



**Figure 5.** Yield as a percentage of that obtained with peat alone when mushrooms were cased with peat plus 12.5% (dark column) or 25% (light column) of various alternative materials.

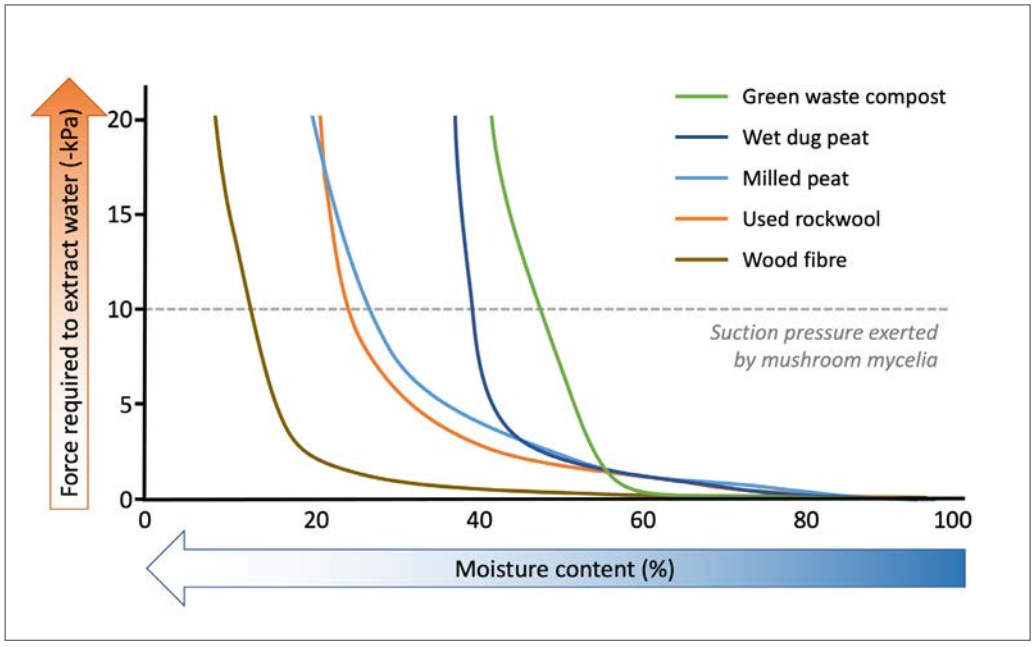



**Figure 6.** Water release curves of some casing materials showing how much water was retained after an increasing suction pressure was applied to a sample. The horizontal line at 10kPa is a typical suction pressure exerted by mushroom mycelium at the start of a flush. It shows that at this suction, very little water (less than 20%) is left in wood fibre for the mycelium to extract from the casing.

"I don't think the answer is in blending peat with other materials," commented Dr Noble. "A full replacement for peat is a better option than simply trying to reduce it as a component of the mix."

When examining potentially useful materials, it is important to consider not just water holding capacity (WHC) when saturated (e.g. after heavy watering), but also how the materials hold on to this water to slow down losses caused by evaporation and drainage.

Wet dug peat is an ideal casing because it has a high water holding capacity when saturated, and holds on to this water so that little drains out. This leaves a good supply of water for mushroom mycelium between waterings. Although wood fibre holds about 80% water when saturated, most of this is released when only a

small suction is applied. On a mushroom bed, the water in wood fibre readily evaporates and drains out, leaving less for the mycelium to extract.

Conversely, green waste compost holds only 60-70% water when saturated meaning that it has to be watered frequently with smaller quantities. However, it holds on to this water better than wood fibre does when a suction is applied. The material dries out more slowly on a mushroom bed leaving a supply for the mushroom mycelium to extract.

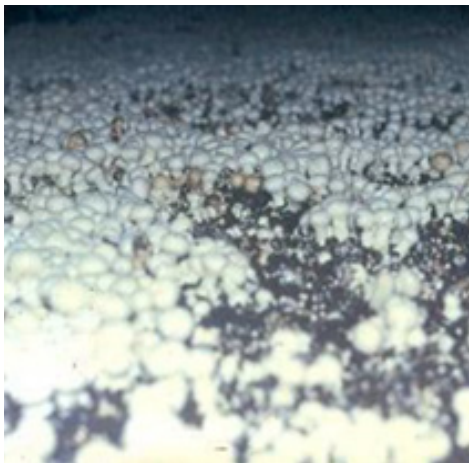
The capacity of materials to hold water is mostly influenced by pore size, and the ability to hold water at different suctions by having a range of different pore sizes within the material or blend of materials. *Sphagnum* moss, preserved as wet dug peat, has an ideal natural range in pore sizes. Avoiding excess mechanical agitation preserves this structure. However, other materials may actually benefit from mechanical intervention to improve blending of materials with large and small pore sizes (e.g. bark and clay).

## Other issues to consider

Mushroom cultivation is not just a matter of producing high yields, other cropping factors must also be considered:

- Some materials are sticky and will cling to the mushrooms
- Some casings produce leggy mushrooms
- Over pinning can be a problem – high yield but small mushrooms
- Case run can be slower with alternative casings, increasing the time taken to grow a crop
- Irrigation practices are likely to need to change
- Risk from Trichoderma (green mould) is increased when peat is blended with other materials.

Material stuck to mushrooms (left), leggy mushrooms (right)



Overpinning (left), slow case run (right)

Green mould (Trichoderma harzianum) on 25% bark casing

- Some organic alternatives can also increase the risks from sciarid flies
- Conversely, bacterial blotch is reduced in some peat-based blends

Dr Noble is optimistic. Despite a few challenges, we are not too far off a peat-free future, and he wagers that by 2030 Australia will be producing high yields of quality mushrooms without peat casing.

We look forward to following the results of his work as it becomes clearer what those alternative casings might look like.

- Peat is a non-renewable resource that will soon be unavailable
- Key criteria for new materials include
  - Water holding characteristics
  - Pest and disease response
  - Yield
  - Quality
  - Local availability
  - Non-competing resource (preferably a waste stream)
- It is highly likely that Australian mushrooms will be grown commercially without peat within the next 10 years

Hort Innovation Strategic levy investment | MUSHROOM FUND

This project has been funded by Hort Innovation using the mushroom research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

International speakers were invited to present at the AMGA conference *Growing the Future Together* with support of the Hort Innovation Mushroom Fund

Sources

https://sdgs.un.org/goals

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| | Advantages | Disadvantages |
|---|---|---|
| **Wet dug peat**<br>  | Free of pests and diseases<br>Low pH and nutrient content<br>Excellent water holding capacity<br>Appropriate pore size, allowing air to reach mycelia<br>Low bulk density<br>Structurally stable and supportive | **Not sustainable due to slow regrowth of peatland (<1mm/year)**<br>**Long travel distances = high freight costs**<br>Biosecurity restrictions lead to import delays<br>Hard to re-wet if it dries out |
| **Coir**<br>  | Renewable and readily sourced within the region<br>Good structure and stability<br>Good water holding capacity<br>Appropriate pore size<br>Easy to re-wet after drying<br>Low bulk density | Must be leached to reduce salt content, requiring large volumes of water<br>Risk of contamination (pests, diseases and chemicals)<br>Imported, increasing freight costs<br>Competition from other users affects price and availability |
| **Spent mushroom compost**<br>  | Available on farm; solves disposal problem so cost-positive<br>Good water holding capacity<br>Appropriate pore size<br>Good structure and stability | High salt content – must be leached before use, requiring large volumes of water<br>Must be heat treated to eliminate pests and diseases |
| **Recycled casing**<br>  | Available on farm; solves disposal problem, cost-positive!<br>Reduces issues with salt content in spent mushroom compost<br>Can be added up to 1/3 without affecting yield | Equipment needed to remove casing from spent compost<br>Must be heat treated to eliminate pests and diseases<br>**Does not eliminate peat from growing system** |
| **Composted wood fibre**<br>  | Renewable and locally sourced<br>High porosity<br>Water taken up but easily lost through evaporation and drainage<br>Low bulk density<br>Structurally stable | May increase requirement for added nutrients<br>Can become compressed<br>Likely to require leaching or steam treatment before use<br>Susceptible to green mould |
| **Green waste compost**<br>  | Readily locally available<br>Inexpensive<br>Moderate water holding capacity and retention<br>Appropriate pore size<br>May suppress some pathogens | Variable characteristics, depending on substrates used and composting process<br>High nutrient content (K and P)<br>Potential for high salt content<br>Risk of contaminants (pesticides, microbes and physical)<br>Must be blended with other materials<br>Relatively high bulk density |

| | Advantages | Disadvantages |
|---|---|---|
| **Composted bark chips**  | Readily locally available<br>Inexpensive<br>Large pore size | Low water holding capacity<br>May require leaching before use<br>Risk of contaminants, especially if not composted correctly<br>May contain organic compounds that inhibit growth |
| **Rockwool**  | Pest and disease free<br>Inert and structurally stable<br>Free of nutrients<br>Good water holding capacity<br>Appropriate pore size and range<br>Low bulk density | Expensive – energy intensive production process plus high freight costs<br>Low buffering capacity<br>Can be hard to re-wet |
| **Used rockwool**  | Readily locally available<br>Potentially inexpensive<br>Neutral pH and low in nutrients | Requires processing and granulation before use<br>Limited availability |
| **Vermiculite**  | Pest and disease free<br>Inert and structurally stable<br>Free of nutrients<br>Large pore size<br>Extremely low bulk density | Expensive – energy intensive production process plus high freight costs<br>Relatively low water holding capacity |
| **Paper and cardboard waste**  | Readily locally available<br>Inexpensive<br>High water holding capacity | High bulk density<br>Source of contaminants<br>Can encourage mould growth |
| **Clays and other by-products from mining**  | Materials may be readily available (some areas)<br>Potentially inexpensive<br>Potential yield improvement (coal tailings)<br>Moderate water holding capacity<br>Generally inert with stable structure<br>Low risk of pests and disease<br>Positive trial data exists | High bulk density<br>May dirty mushrooms<br>Can adversely affect casing conductivity |

**Figure 4.** Pros and cons of investigated raw casing materials

# MUSHROOM FARMING IN UKRAINE

**By Paulette Baumgartl**

**Despite the challenges of war in Ukraine, this world leader in food production is advancing rapidly with increased production capacity, poised to deliver quality mushrooms to export markets.**

Commercial mushroom growing in eastern Europe is a relatively new industry, with consumption per capita still low. However, before the escalation of the war in Ukraine, production of mushrooms in many of the former Soviet countries was trending upwards. This growth has mostly been driven by an increase in local consumption.

Attending the recent Australian Mushroom Growers Conference, Ukrainian mushroom expert Maksym Yenchenko from the UMDIS[1], with his colleague Inna Ustylovska, showcased the Ukrainian mushroom industry in a presentation that spanned horticulture and geopolitics.

## A growing industry – mushroom production and consumption in Ukraine

Traditionally, Ukraine and other eastern European countries have consumed considerably fewer mushrooms than in Western Europe or Australia (see Table 1). However, increased local interest and export demand mean there could be a bright future ahead for Ukrainian growers.

Ukraine knows how to grow and export food. It is the second biggest country in Europe with a population of 44 million people and is well known for its agricultural exports.  It provides half of the world's sunflower oil

[1] https://www.umdis.org/umdis-mushroom-informational-agency/

*Each country in Europe has its trends, challenges, and opportunities. Countries like Germany, France and the Netherlands are enjoying growing consumption of mushrooms as plant-based diets are becoming more popular, but despite the high value placed on provenance (preferably locally grown), labour shortages and increased production costs will see this demand met with imports from the east.*

| Country (population, million) | Estimated production 2021 (tonnes) | Estimated annual consumption (kg/per person) |
|---|---|---|
| **Ukraine (44)** | 65,000 | 1.5 |
| **Georgia (3.7)** | 2,000 | 0.6 |
| **Armenia (2.9)** | 3,000 | <1.0 |
| **Azerbaijan (7)** | 3,500 | 0.3 |
| **Uzbekistan (34)** | 17,000 | 0.2 |
| **Kazakhstan (19)** | 2,500 | 0.3 |
| **Moldova (2.6)** | 2,500 | 1.0 |
| **Poland (38)** | 370,000 | 1.5-2 |
| **Russia (143)** | 115,000 | - |
| **Geographical Europe (including Poland, Netherlands, Germany, Spain, France, Russia and Ukraine)** | 1,500,000 | 2.0 |
| **Australia (25.7)** | **68,000** | **3.5** |

**Table 1.** Production and consumption of mushrooms across Europe.

(5 million tonnes in 2021/22[2]), 10% of its wheat, 12% of the corn, and 17% of the barely. Even Ukraine's flag is a symbolic representation of agriculture, with blue skies over golden fields.

So where do mushrooms fit it? Clearly compost raw materials are not a problem for Ukraine, and despite consuming half the amount than that of Australians per year, Ukrainian growers produce a comparable number of mushrooms across 300 farms. Mr Yenchenko noted that most of these farms are small, with a simple growing room behind the house. About 50 commercial scale farms are producing most of the mushrooms. Again, comparable to Australia.

The first mushroom farms emerged in 2004, and the industry has grown rapidly, recording 50,000 tonnes in 2015. Mushroom entrepreneurs, attracted by the quick return on investments, purchased second-hand equipment from the Netherlands. However, production has now stalled as the nation waits for the war to end and hopes for entry into the European Union with its huge (potential) market.

And with a farm gate price currently at just over US $1/kg, importers are keen.

Culture meets horticulture: interpretive dance and art auction at the Ukraine Mushroom Days.

Despite these low prices, significant barriers to exporting remain, and it is not just borders. War, obviously, and everything it brings, is wreaking havoc. High interest rates for farm investments coupled with no government support mean that farmers cannot expand and invest

[2] https://www.reuters.com/markets/europe/ukraine-202223-sunoil-output-seen-35-49-mln-t-analyst-2022-09-24/

in the infrastructure required for export. A single grower needs to produce 15 tonnes to fill a truck, plus have access to cold storage and the specialised packaging required for transport.

Mr Yenchenko is optimistic that many of these barriers can be overcome if and when Ukraine joins the European Union.

Behind the smile and the jokes, Mr Yenchenko's images of destroyed farms, friends in exile, friends in bunkers, farmers protecting their farms, and families separated, reveal the stark and sobering reality of war.

Mr Yenchenko and his team at the UMDIS are determined to keep progressing the mushroom industry. They are using this time to support growers and work on translations of important mushroom growing literature to ensure that once the war ends, mushroom growers are ready and well-prepared for the opportunities that are waiting.

In a further nod to a brighter future, plans are already afoot for the 2023 Mushroom Days. This key industry event (the third largest mushroom expo in the world, attended by 400 people from 20 countries) has endured a forced hiatus in 2022, but Mr Yenchenko welcomes everyone to the 2023 expo, which, he defiantly hopes, will be held in Crimea.

Ukraines oldest farm with 36 rooms produces 100t/week and is the biggest mushroom farm in Ukraine

Farms are starting to install solar panels to keep energy prices down

The diversity of farms is high, from a simple growing room in the back yard, to large farms with 36 rooms, and Dutch style farms, increasingly covered in solar panels. All mushrooms are hand harvested for the fresh market. Phase III compost is now used in 80% of the farms, a figure that has doubled in the last few years, as growers adopt more advanced methods.

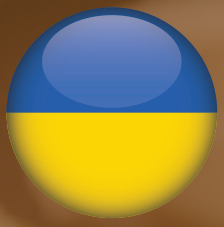
Ukraine has six main compost yards (now down to five as one has been destroyed), with the Belgian company *Agaris* responsible for more than 70% of production.

Oldest compost yard in Ukraine. Composts are typically made from straw and chicken manure, both present in abundance

Most growers follow the Polish method of growing, where the mushrooms are produced from Phase III blocks

When war hits and only local food is available

The reality of war: A destroyed mushroom farm.

| Australia | | Ukraine |
|---|---|---|
|  | |  |
| **3.5kg** person/year | CONSUMPTION | **1.5kg** person/year |
| **68,000** tonnes | PRODUCTION MUSHROOMS | **65,000** tonnes |
| Approx. **80%** | USE OF PHASE III COMPOST | Approx. **80%** |
| **0.01%** | EXPORT | **0.02%** |
| **40** | NUMBER OF COMMERCIAL SCALE FARMS | **50** |
| **1,700** tonnes | MUSHROOMS SENT FOR PROCESSING | **2,000** tonnes |
| AU **$6.30** /kg | FARM GATE PRICES | **$1.70** AU /kg |
| AU **$1100** /week | PICKERS WAGES | **$170** AU /week |

# STORING CHEMICALS SAFELY

**By Dr Jenny Ekman**

**The contents of a chemical shed is not unlike someone's garage. A messy garage gives a different message from one that's swept, with neatly ordered tools and equipment, not unlike sheds for storing chemicals.**

A chemical shed may not be the most glamorous, action packed or exciting place on farm, but it can certainly give a strong impression as to how the business is run.

A well-kept, clean, and orderly chemical shed suggests a clean and orderly business. An auditor encountering a dirty, disorganised shed may well expect other aspects of the food safety system to be likewise, viewing the business through red – as opposed to rose – tinted glasses.

Compared to some other horticultural businesses, mushroom farms are light chemical users. There might be some herbicide to keep the weeds down around the property, insecticide to manage flies, and a few specific products for weed mould. And, of course, salt for disease management.

However, it is cleaners and sanitisers where many farms will have a large volume of chemicals. High standards of farm hygiene are not only essential to keep mushrooms free of human pathogens, but also to control pests and disease. Keeping farm equipment and facilities clean and sanitised is clearly core business.

It is easy to become casual about cleaners and sanitisers. Most people have a bottle of bleach in their laundry, tablets for a dishwasher and alcohol-based hand sanitiser somewhere around the house. However, in their concentrated form all of these are powerful chemicals.

Powerful cleaning agents such as 'truck wash' and other detergents act by lowering the surface tension of water, allowing it to bind more easily with dirt and grease. They can be either alkaline or acidic. Some products can contain formaldehyde. Care should always be taken to avoid contact with eyes, mouth and skin.

Sanitisers work by reacting with organic compounds. Organic compounds include human pathogens such as E. coli, fungal spores like Trichoderma, compost and algae. Human skin, eyes and lungs are also organic compounds. While sanitisers are safe once diluted, in their concentrated form they can adversely affect the human body very fast indeed. They are also corrosive to equipment, especially at strong concentrations.

## Oxidiser or corrosive?

Some sanitisers, such as hydrogen peroxide and calcium hypochlorite granules, are powerful oxidisers. They can release toxic gases if they contact other chemicals, as well as potentially increase the risk of a fire or explosion.

Other sanitisers are corrosive. Sodium hypochlorite (bleach) is a corrosive chemical. Concentrated bleach can burn skin, causing red welts. Inhaling the vapour can burn the eyes and throat, while any contact with the eyes requires urgent medical attention. Some people are allergic to chlorine, or develop allergies after repeated exposure.

Even dilute sodium hypochlorite reacts with skin – the "soapy" feeling you get after contacting bleach is due to a reaction between sodium hypochlorite and the natural oils on your skin.


**Figure 1.** Chemical stores should separate sanitisers from pesticides with products stacked on shelving - not piled on top of each other.

Like many cleaning agents, sodium hypochlorite is highly alkaline. Contact with an acid releases poisonous chlorine gas, which can burn eyes, throat and lungs, and generates heat, leading to the potential for fire or explosion.

Simply adding water to concentrated bleach also triggers the formation of chlorine gas. This is why concentrated bleach should ALWAYS be added to water; NEVER add water to bleach.

Tips for storing sodium hypochlorite

- Store below 20°C in airtight containers; high storage temperatures can lead to release of oxygen, resulting in build-up of pressure and increased possibility of spills.
- Ensure the shed is well ventilated and weatherproof.
- Install bunding around the edge of the store to capture any leaks or spills, with the volume sufficient to retain the entire volume of the largest container stored (e.g. 20L drum).
- Never store liquid bleach above dry products, such as calcium hypochlorite.

Another sanitiser likely to be found on many mushroom farms is San-I-Mush. San-I-Mush is registered for a wide range of purposes, including sanitising growing trays, walls, and floors.

San-I-Mush is a mixture of iodine, agents to make iodine soluble in water, and 85% phosphoric acid. Iodine is a potent sanitiser against most microbes, including bacteria, yeasts, and moulds. It is most effective when combined with an acid, and San-I-Mush has a pH of approximately 3. It is therefore important not to mix San-I-Mush with alkaline cleaner or bleach.

Quaternary ammonium compounds (Quats) may also be sometimes found on mushroom farms. These are highly effective at killing bacteria, fungi, and viruses. They can disinfect water and control algae and are included in many household detergents and all-purpose cleaners.

While they can be used very safely, they must NEVER be ingested. Quats are poisonous if absorbed by skin contact, inhalation of fumes or eye exposure. Equipment sanitised with quats should be washed down with clean water.

Both Quats and San-I-Mush need to be stored below 30°C and out of direct sunlight.

Sanitisers need to be kept separately to pesticides and other chemicals, including fertilisers and other nutritional amendments. Ideally they should be separated by a wall dividing the shed, or stored in a different shed altogether.

## A good chemical shed

### The shed itself

- Lockable, with appropriate signage (e.g. flammable, toxic)
- Fire and weather resistant, so as to keep products away from direct sunlight and as cool as possible
- Well ventilated, preferably with cross flow as well as a roof exhaust vent
- Bunded floor, with enough capacity to contain 25%

of the total volume or 100% of the largest drum of liquid

- Strong metal shelving, so that drums don't need to be piled on top of each other

**Inside and around the shed**

- Emergency plan with contact numbers on shed wall or door
- Fire extinguisher
- Spill kit with absorbent material, as well as broom, mop and other cleaning items
- First aid kit, safety shower and eyewash station

**In the office**

- File containing Safety Data Sheets for all stored chemicals (never store in shed)
- Extra copy of emergency plan with contact numbers

**Stored products**

As previously stated, sanitisers should be kept separately from other chemicals. Separate flammable materials from non-flammables and keep them away from materials that burn easily – like oil or cardboard.

Liquids should be placed below any solid products, such as granules.

The shed should be organised so that herbicides, insecticides and fungicides are placed on different shelves or racks, preferably labelled to make it easy for staff to find the correct product.

Products must always be stored in their original packaging with label intact: NEVER decant into unlabelled containers, especially ones that were previously used for food or drink.

If you have any highly toxic or flammable chemicals, they need to be stored in a purpose-built metal cabinet.

A regular stocktake is important to identify and remove products that are past their use-by date, or with

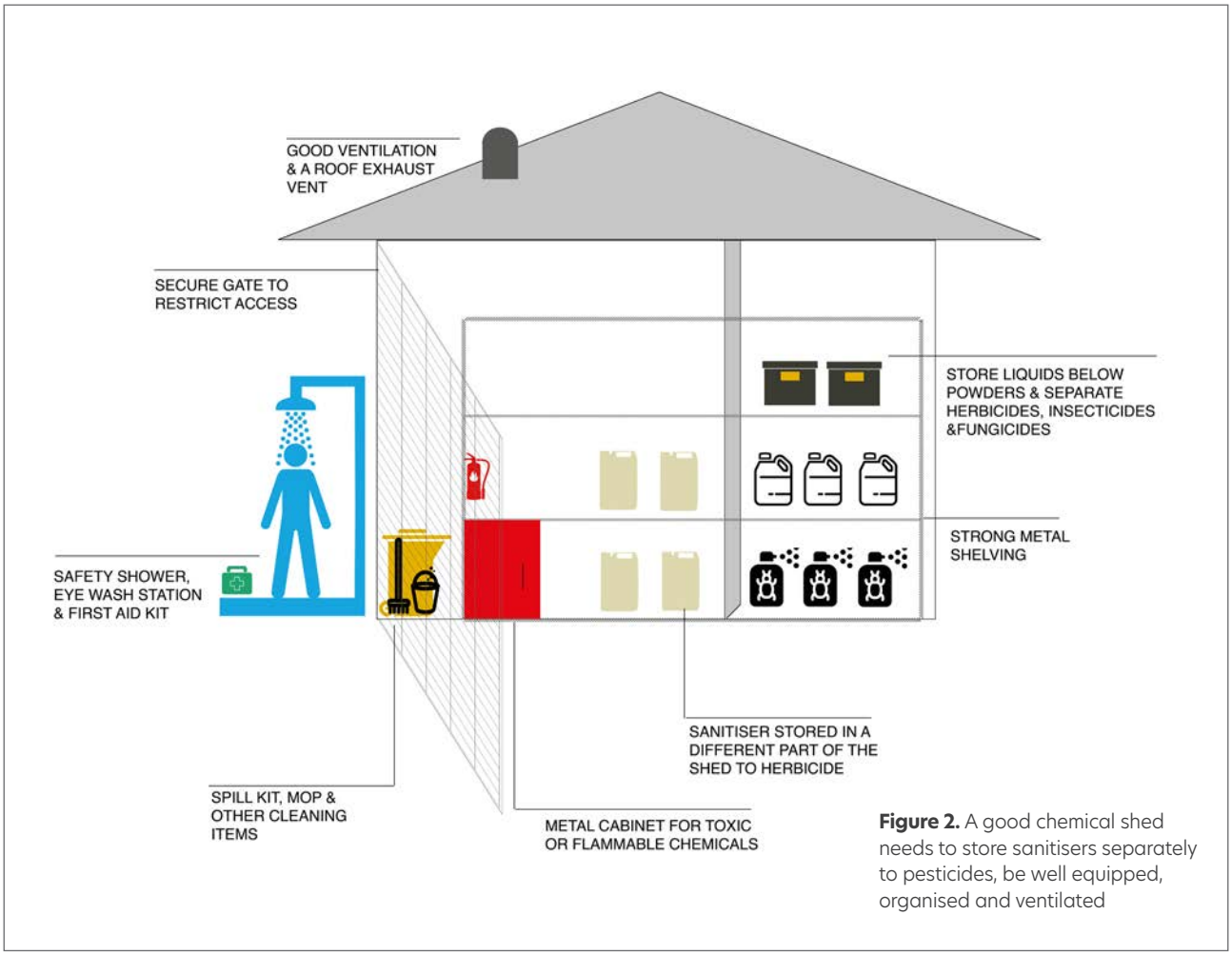



**Figure 2.** A good chemical shed needs to store sanitisers separately to pesticides, be well equipped, organised and ventilated

packaging that is starting to rust or leak. It is also useful to know what is in there and how much, so that more can be ordered as needed.

## A good mixing area

Storing the chemicals safely is one thing, preparing them for use is another. A specific area should be set up for mixing chemicals, whether inside the shed, or next to it. Designing this properly will make everyday tasks faster and easier, such as mixing solution to replenish foot baths, or preparing spray bottles with sanitiser.

The area used for mixing chemicals needs to be covered, well ventilated but also not too breezy; pouring chemicals in a blustery wind is a recipe for disaster.

The mixing bench needs to have an impervious surface, such as metal or glass, rather than a wooden surface that can absorb spilled chemicals. It needs to be well separated from the packing area and away from drains or waterways.

The mixing area should be equipped with;

- Clearly labelled measuring containers for each product used regularly
- A calibrated balance with protective cling wrap or foil, that can be easily changed
- Good lighting
- Personal protective equipment (PPE) that includes goggles, rubber gloves and a washable apron, as well as a respirator if volatile and hazardous chemicals are being prepared
- Cleaning wipes in case of spillage

It is clearly essential that staff involved in mixing chemicals (and applying) are properly trained. Providing clear, written instructions on dilution rates and mixing is the best way to ensure chemicals are used properly.

For example, mixing up a sprayer with 200ppm bleach could state:

1. Put on gloves and safety glasses
2. Fill backpack unit with water to the 10L mark
3. Carefully measure out 32ml of bleach (12.5% sodium hypochlorite) from a drum using the yellow funnel and small measuring jug labelled "bleach only"
4. Add bleach to backpack unit
5. Fill backpack unit with water to the 20L mark
6. Secure cap

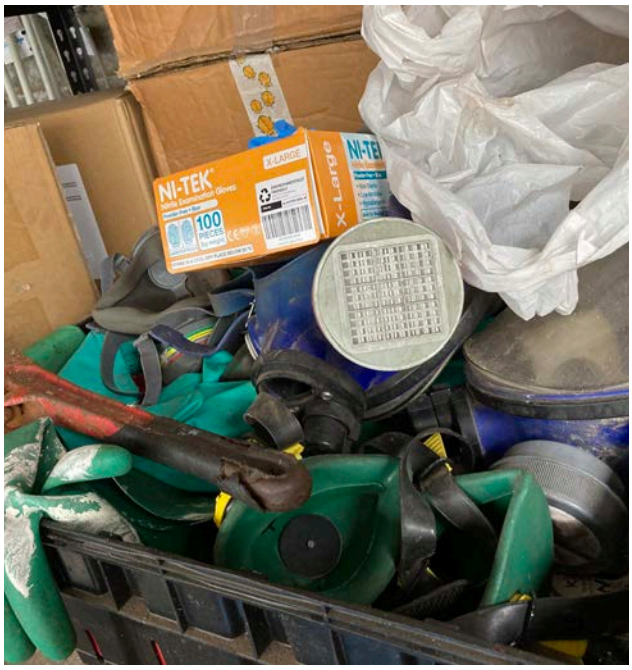



**Figure 3.** PPE should be kept in good condition and stored in a specific area so it is ready to use.

This can be combined with a full work instruction sheet, as in the example shown in the breakout box for foot bath maintenance.

Staff need to understand what to do if a spill occurs or they have accidental contact with a concentrated chemical. It is essential they don't eat, drink or smoke while mixing sanitisers or pesticides. They should also try to mix only what is needed, as unused chemical needs to be disposed of safely – it can't just be tipped down the drain.

In some locations, empty drums of regularly used products such as bleach can be recycled directly. However, most containers need to be triple washed before collection under the DrumMUSTER programme. DrumMUSTER will not accept containers that still have residues on either the inside or outside, including the thread and cap.

The best time to rinse the empty container is when preparing the same chemical, as the rinse water used can be added to the spray tank during mixing.

## Example - Foot mat maintenance

*Top up disinfection mats daily and fully replace solution weekly.*

**Each Monday morning** - Collect disinfection mats (total three) and take to the bunded wash down bay at the rear of the facility. Brush down mats to remove adhering soil then wash thoroughly using the hose provided, rinsing until the water runs clear. Allow mats to drain for 30 minutes then return them to their locations in front of entry doors.

Put on gloves, safety glasses and protective boots.

Mix a solution of SAN-I-MUSH according to the label directions (60ml/5L) e.g. Measure out 72ml (using the measuring cup labelled "SAN-I-MUSH only"), add to 6L water inside the watering can (labelled "SAN-I-MUSH only"), then mix well using the plastic stirring stick. Use the solution to fill one disinfection mat. Repeat with the two remaining mats.

**Each other morning** - Mix a solution of SAN-I-MUSH as previously, adding 6L water to the watering can (labelled "SAN-I-MUSH only") then adding 72ml of SAN-I-MUSH and mixing well using the plastic stirring stick.

Add sufficient solution to each disinfection mat so that it is fully hydrated: Note that each mat can hold up to 6L of disinfectant solution. Leftover solution can be left in the watering can and used as needed.

### In summary

Good hygiene is the number one defence against mushroom diseases, as well as ensuring food safety. While physical measures such as cookout are important, thorough cleaning followed by sanitation is essential to keep crops healthy and clean.

However, detergents and sanitisers need to be treated with respect. It is easy to become complacent, but these are powerful chemicals, especially in their concentrated form. It is important they are stored correctly. This ensures that they don't present a danger to staff or equipment as well as preserved in active condition.

Sanitisers and detergents need to be kept separated from pesticides, such as those used to control flies or weed moulds. Providing proper equipment and facilities to store and mix chemicals, as well as clear instructions to staff, will ensure they are mixed and applied correctly.

A well-kept chemical shed can therefore help keep staff safe and auditors happy.

Hort Innovation Strategic levy investment | MUSHROOM FUND

This project has been funded by Hort Innovation using the mushroom research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

# PHONE A FRIEND FOR ON-FARM HELP

When you have a pest or disease problem on-farm that you are unsure of, or when you need to confirm the right way forward, what do you do? For Neil Newman of Country Farm Fresh Mushrooms, the answer is as close as the computer and the phone.

Neil said that in a small farming business, operators wear many hats.

"The simple fact is that you cannot be fully across everything, so you need access to the right resources promptly to operate effectively and efficiently. The levy-funded project Pest and Disease Management and Research (MU16003) is one of the resources that helps us in numerous ways on the farm."

Neil explained that the first step was to use the AGORA website to work through available information when he ran into a problem. The library contains a wealth of information curated by the project team, with specific attention to articles of interest for the Australian industry.

"If I am still uncertain about anything, the next step is to contact the project team and talk through the problem.... (they) can better understand how the farm operates through one-on-one discussions.

"Having someone who has the on-farm knowledge and knows the breadth of available information is invaluable. It is a great asset to access information and support and then use that information to suit our business. And importantly, the project team can also research materials and email the links for articles of interest.

"Our farm thankfully does not have a lot of issues, but this type of support helps us minimise risk and manage any problems that occur in an effective and timely manner."

He said the information on available chemicals and correct chemical usage was highly worthwhile.

"Having this information, knowing how to prevent issues from occurring, and understanding the threshold limits, allows us to take action sooner and with better and safer practices. Ultimately, this allows us to produce more quality mushrooms.

"In our industry, there are plenty of consultants providing advice, but if you go blindly and use what they are telling you to use, you could be using the product wrongly, or you may not be allowed to use it in the first place.

"New products require an assessment of procedures, particularly when it comes to farm hygiene. By checking with the project team, you can be sure that your QA documentation is aligned with any changes.

"The right way may take a little longer, but by doing the right thing, you are protecting yourself firstly as a business and secondly the industry as a total," he said.

## AGORA Resources

The AGORA website is central library of mushroom pest, disease, and hygiene information. Hundreds of resources are available, including both locally produced fact sheets and articles and publications from around the world.
There are also videos demonstrating sampling methods, spot treatments and pest and disease identification.

Other topics include the important roles of compost quality, farm hygiene and other factors.

The AGORA website is password protected. To obtain a login please contact
Judy Allan (m: 0427671057, judyallan@bigpond.com)
*or*
Chris Rowley (chris.rowley@optusnet.com.au)

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**MARKETING UPDATE**

# MUSHROOM IN-STORE SAMPLING

WHEN IT COMES TO PLANNING DINNER, NEARLY HALF OF AUSTRALIAN COOKS ARE LAST MINUTE LARRYS, PROVIDING THE PERFECT OPPORTUNITY TO REMIND SHOPPERS OF THE WONDERS OF MUSHROOMS AS THEY DO THEIR DINNER SHOPPING.

**By Paulette Baumgartl**

With this key statistic in mind, the Hort Innovation marketing team developed the *Mushroom In-Store Sampling Program*.

Capitalising on the prevalence of impulse buyers in Australian supermarkets, mushroom ambassadors were at the ready to inspire eager shoppers with mouth-watering aromas, delicious tasting samples, and simple recipes to cook at home that night.

The in-store sampling, part of the levy-funded MU21503 project, was endorsed by the Mushroom SIAP to drive category growth with point of purchase conversion by inspiring shoppers with easy mushroom recipes to taste while in store.

The overall objective of the campaign is to contribute towards the FY22 Australian Mushrooms Brand vision to push long term domestic growth for the mushroom category.

The initiative is part of an effort to make Australian mushrooms a staple ingredient in the Australian home by driving increased consideration and frequency of purchase, and answer the underlying question:

*"How do we inspire consumers to consider and use mushrooms more often?"*

Emma Day, marketing manager at Hort innovation, explains that this initiative is part of a four pillar plan that underpins the mushroom marketing strategy (see *MushroomLink, Issue 1 Winter 2022, page 19* for the full marketing strategy).

"This project is part of our Pillar 3: Win in Retail, which aims to increase the visibility of mushrooms in retail settings," she said.

"In addition to in-store sampling, other elements of Pillar 3 include in-store advertising, online shopping advertising and out of home (OoH) advertising panels on the path to purchase, i.e., close to, or inside, retail stores.

"As the project runs until the end of the year, we are still collecting data, but customer feedback has been very positive," Emma added.

The in-store sampling program (10am-2pm) and (3pm-7pm) ran across the country (except Northern Territory) in Woolworths and Coles stores. Demonstration tables, branded with Australian mushrooms imagery, also contained additional marketing collateral including


A mushroom ambassador helping shoppers discover the delights of Australian mushrooms

business cards and a QR code linked to the Australian Mushrooms website for more mushroom recipes.

Australian Mushroom Brand Ambassadors prepared two recipes, namely vegetarian 'meatballs' and mushroom mini toast. Australian families love meatballs, and this vegetarian version taps into the growing trend for people to reduce the amount of meat in their diets.

The mushrooms on toast recipe aligns with the AMGA-run Café Culture foodservice campaign, #mymushroomtoast, recently won by the Guyala Café in Cairns.

A total of 276 in-store sampling sessions have been completed so far, with sessions ramping up toward Christmas to complete 600 in total by end of 2022.

The current results are as follows:

- Total samples: 23,736
- Total interactions: 32,568
- Average samples per session: 86 (Target: 80)
- Average interactions per session: 118 (Target: 115)

Samplers love the idea of mushrooms being added as an alternative to meat and using them in recipes they wouldn't usually consider.

Brand Ambassadors report samplers typically only consider mushrooms if a recipe calls for them, but enjoyed the new alternative recipe samples presented, and commented positively.

Some examples of their positive responses:

**"I really love this recipe, very simple but tasty"**

**"The mushroom, garlic and herbs pair perfectly together"**

**"Delicious! I am always looking for other things to do with mushrooms"**

**"Yummy and healthy vegetarian option"**

**"Absolutely delicious, I'm going to get the ingredients now and make that at home"**

**"The best vegetarian meatballs I have tried, so healthy!"**

Customer feedback suggests that they love the vegetarian options and the aroma of the garlic and mushrooms throughout the store, which encourages tasting. The business and stand-up cards have been very successful as many samplers are interested in the recipes for the meatballs and mini toasts.

Brand Ambassadors have also been encouraging samplers to look through the "recipes" tab to view these recipes and many others, which highlight the versatility of mushrooms. This has been a key talking point at all sessions.

*Look out for the full results of this initiative in MushroomLink 2023.*

Hort Innovation Strategic levy investment | MUSHROOM FUND

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# HORT INNOVATION MUSHROOM FUND PROJECTS

## NEW PROJECTS

| PROJECT NAME | PROJECT CODE | ORGANISATION | PROJECT DESCRIPTION |
|---|---|---|---|
| **Mushroom education resources** | MU22002 | Primary Industries Education Foundation Australia | This short project is developing two mushroom-focused teaching resources that will encourage secondary school students to have a greater understanding and interest in the mushroom industry. |
| **Evaluating existing and potential ergocalciferol (vitamin D2) health claims for mushrooms** | MU22004 | Nutrition Research Australia | This project is summarising the nutrition content and health claims that can be made about vitamin D in mushrooms that meet the Food Standards Code so that mushrooms can be credibly and legally promoted as a key source of vitamin D to consumers. |
| **Marketing campaign evaluation modules FY22/23** | MT22200 | Fifty-Five Five | This project examines the impact of Hort Innovation's Mushroom and other levy-funded marketing campaigns. These insights will provide Hort Innovation and industry with a clear view of how the campaigns have performed in driving salience, specific messages and purchase intent. |

## 2022 COMPLETED PROJECTS

| PROJECT NAME | PROJECT CODE | ORGANISATION | PROJECT DESCRIPTION |
|---|---|---|---|
| **A scoping study to review fungi based global innovations to inform product development opportunities** | MU20004 | AMGA | Running from 2021 to 2022, this short investment explored the use of mushrooms in plant-based food product innovation and informed the industry of new market opportunities and their potential viability in the Australian context.<br>This project yielded the following key outputs:<br>• A mushroom product compendium of over 180 products across 13 categories<br>• Three deep explorations (case studies) of novel mushroom-based food innovation activities<br>• Key insights and considerations from each case study<br>• Three novel food product concepts using Agaricus bisporus. |
| **Consumer behavioural and retail data for fresh produce** | MT17015 | Nielsen | This multi-industry investment provided regular consumer behaviour data and insight reporting to a range of industries, through the Harvest to Home platform (www.harvesttohome.net.au). |


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