Australian MUSHROOMS JOURNAL

Edition 1 - 2019

Hort Innovation
Strategic levy investment

MUSHROOM FUND

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Australian

Mushrooms Journal

ISSUE: EDITION 1 - 2019

Contents

MUSHROOM INDUSTRY JOURNAL is a levy funded publication, compiled on behalf of the Australian mushroom industry.

EDITORIAL
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PUBLICATION DATES: Winter, Spring, Summer, Autumn

COPY DEADLINE: Six weeks prior to the cover date

SUBSCRIPTIONS
This project Communication program for the Australian Mushroom Industry 2016-19 [MU15001] has been funded by Hort Innovation using the mushroom research and development levy and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture. The Journal is available to levy payers and others involved in the Australian Industry. The Journal is distributed as an electronic copy only. Requests to be included on the distribution list should be directed to the Editor.

LETTERS TO THE EDITOR
Letters to the Editor from readers on subjects of interest to the mushroom industry are welcomed and encouraged. All contributions should be emailed to the Editor - chrisrowley@optusnet.com.au

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Tim Adlington, Chairman, Australian Mushroom Growers Association

AMGA Chairman's Report

The first column for the year is an opportunity to reflect on the past year and look ahead at the challenges and opportunities for the coming year.

As some of you may know I underwent surgery for a significant health issue late last year, so my first challenge is to get back to good health. Thank you to all those friends and well-wishers who have checked up on my progress and encouraged me to get back on my feet. Thankfully I am now well on the road to recovery and looking forward with enthusiasm to the year ahead.

As Chairman I am particularly pleased with the progress made over the past 12-18 months in unifying the industry and in turn ensuring the working relationship with Hort Innovation is both strong and effective. These two factors open the door to real progress, and this shows in the way in which industry input has helped shape the development of the Marsh Lawson Research Centre. In the coming year, I expect the Marsh Lawson Committee to again play a significant role in developing new projects for consideration by the Strategic Industry Advisory Panel (SIAP).

An example of the type of valuable work progressed through the committee is a recently contracted project examining production waste streams, with a view to improving profitability and efficiency in the industry. While this Journal has a more detailed story on Page ?, it is this type of research that can pave the way to deliver dollar benefits to individual businesses and the wider industry.

Over the traditionally quiet Summer period for mushrooms, marketing efforts have continued to push the Australian Mushrooms messages. This month Australian Mushrooms is back on the radio with a range of ads that focus on taste and ease of preparation. From late March through to 20 April, the ads appear on television. Please take the time to read through the marketing section of this Journal to stay up to date with how your levy dollar is spent in promoting mushrooms.

This year the extreme weather and continuing drought has impacted not just our industry, but other primary producers across Australia. From a mushroom industry perspective, this has many flow-on effects, the most significant one being the difficulty in sourcing – and the cost – of raw materials for composting. Hopefully, in the coming months, we will see a true break in the weather and a return to more normal seasonal conditions.

The AMGA has a responsibility to act in the best interests of industry, and its reputation has been built on the back of doing just this over many decades. Over the coming year, the AMGA intends to further strengthen its role as a strong and united voice, working on your behalf to increase the productivity and profitability of our industry. We are conscious of the need to deliver a real benefit to all our members, big and small, and to continually address those issues that affect us all.

To assist in this process, the Association has appointed Michael Walker to the role of Project Officer with the Association. While his role will be to work with the Board and other staff across a wide range of projects, a key initial priority will be to examine and expand the service benefits offered through the Association. The possibility of negotiated discounts on inputs such as power and fuel, will all be considered as part of this activity. If Michael contacts you in the coming weeks for your thoughts, please give him the feedback he needs to progress these membership issues on your behalf.

You will note that the report from the General Manager, Sally Heukers has not been included in this edition of the Journal. Sally has been on extended sick leave since December and the Board wishes her a a complete recovery from her current illness.

Tim Adlington

Much much easier hits the airwaves **on radio and television**

Consumers will see and hear a lot about Australian Mushrooms with the "chop chop" campaign scheduled across a range of media channels across the country in the first half of 2019.

The campaign builds on previous marketing and will appear on radio, television, out of home locations, and digital media.

The "chop chop" creative, with a focus on taste and ease of preparation, will be at the centre of the messaging, having performed well in recent consumer research.

Radio

The start to the year will see Australian Mushrooms back on the radio. The radio advertising, featuring Australian Mushrooms Ambassador, Miguel Maestre, will run from 3 February until 16 March, targeting listeners of metropolitan radio in Sydney, Melbourne, Brisbane, Adelaide and Perth.

The 15 second and 30 second radio ads can be heard by clicking on the images below:

Mushroom lover, Miguel Maestre knows how to make everyday meals much much yummier.

"It's easy, slice up some mushrooms and toss them in. Chop chop and its done."

For tastier Bolognese, omelettes and more just add mushrooms.

"Chop chop and its". Yum!

In-store sampling

The message will also hit home to consumers as they shop, with in-store sampling running in Coles, Woolworths and independent stores from 14 February, concluding on 11 March. With the focus on ease, the sampling recipe is the Mushroom Noodle Stir Fry, providing a mushroom twist to a family favourite that can be made in minutes

Out of home advertising

Out of home advertising, made up of street-side bus shelters and panels in shopping centres, is scheduled to run from 3 March through until 11 May in Sydney, Melbourne, Brisbane, Adelaide, and Perth, with the addition of northern and southern New South Wales during this burst. The bus shelters will target consumers with more dwell time and the retail panels will reach shoppers on their journey to the point of purchase.

Digital advertising

The campaign will be further reinforced using digital media channels such as YouTube and Spotify. Ads are scheduled to run from 3 March through until 6 July. Spotify will be running a mix of 15 second and 30 second ads, and YouTube will be showing the 6 second bumper ads which have continued to prove successful. These ads will run nationally.

Television advertising

The television campaign is scheduled to commence on 24 March and conclude on 20 April. The reach of this component of the campaign will be extended to include not only the major metropolitan areas but with the addition of northern and southern New South Wales, regional Queensland and Tasmania.

Website

A new and improved Australian Mushrooms website will be unveiled in mid-March. With a fresh new look and feel, it has been designed to deliver even more for Australian consumers.

The new site is all about the recipes and will tap into the star power of charismatic Australian Mushroom Ambassador, Miguel Maestre. Understanding what our consumers want when they visit our website has been core to the new design – we want people to be able to find what they are looking for (and more) easily and quickly, giving them a good experience and more likelihood of returning.

The site will continue to deliver inspiring recipes supporting the messaging of taste, ease and good health. An update on the new site will be included in the March edition of the Industry Update e-newsletter.

When you next visit the website don't forget (if you haven't already done so) to sign up to receive the latest mushroom recipes and news. The latest edition contained a great recipe for BBQ mushroom chicken bombs from Miguel Maestre and some top grilling tips from Weber Grill Specialist Laura Romeo.

Above: A series of farm tours in planned to build even strong links with the foodservice sector.

Foodservice focus continues

Over the past 18 months, Australian Mushrooms has ramped up activities in the foodservice area with a series of farm tours designed to reach foodservice industry professionals. While these tours are scheduled to continue, a project has also been funded to examine the foodservice sector in more detail.

Food Industry Foresight is undertaking the multi-industry foodservice project with costs shared between the mushroom, onion and avocado industries. The project commenced in mid-January and will conclude in late May. Importantly, the project will also deliver an off-the-shelf Australian Foodservice Report, which will be reviewed, and the findings considered in combination with the custom research findings as part of longer-term planning for this sector.

Following up the series of successful farm tours during 2018, Straight to the Source will manage the foodservice tour project during 2019. Planning is now well underway with dates confirmed for:

- New South Wales (25 February);
- South Australia (13 March);
- Victoria (26 March); and
- Queensland (18 June).

The tours have been designed to provide leading chefs and foodservice operators with a unique insight into the mushroom industry. The tours held to date have received positive responses from participants and opened the door to develop stronger links into the foodservice sector for Australian Mushrooms.

Social media – always on

With the weight of social media seemingly everywhere in the news, it is not surprising that it is one element in the marketing mix that is "always on". And because it is always on, it provides a regular opportunity to communicate with fans and followers, delivering inspirational and delicious recipes sourced from Miguel and other social media influencers.

Pleasingly over a long period of time, the social media team has managed a high level of engagement, which means the information provided is hitting the mark and developing a dialogue with consumers, maintaining engagement rates above industry average.

Special events like the recent Facebook Live with Miguel Maestre help to add that little something to the delivery and keep followers and fans talking about Australian Mushrooms. Typically, this type of event gathers thousands of likes, comments and shares, all of which help spread the mushroom message even further – and ultimately, more meals cooked with mushrooms.

New Recipes

When it comes to recipe development, considerable effort is required to keep things inspirational and in line with the strategic marketing approach as well as current food trends. Development of the next batch of new recipes is well underway, with the first recipe due to be unveiled in March, on the new website.

The new Phenomenom is gettting kids **excited about veggies**

Getting kids excited about eating vegetables is the aim of a free educational program funded by Hort Innovation. It's all about increasing the education around and attitudes toward vegetables amongst children, their teachers, parents and caregivers.

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"Phenonenom" is the brainchild of a teacher, children's book author, television host and ex-MasterChef contestant Alice Zaslavsky and combines 25 episodes and associated curriculum-aligned resources that are designed to integrate vegetables into existing classes for grades 3-6, all easily searchable via an interactive website.

While the vegetable industry initially commissioned the program, it is now attracting the support of other industries which now includes mushrooms and onions, who can see the value of investing in educating children in an engaging kid-centric manner.

According to the most recent Australian Health Survey, just 5.4% of children are eating the recommended five serves of vegetables per day. [While mushrooms are technically neither a vegetable or a fruit, they are included as a vegetable in the Australian Dietary Guidelines.]

The series combines the history of cuisine and agriculture with lessons about art, maths and science, all with a little help from celebrity chefs, athletes, a Mars One astronaut candidate and experts across nutrition, psychology and native foods.

Research undertaken during the development of the program highlighted that kids were watching freely available online 'snackable' content featuring kids their own age. Phenomenom has tapped into this, with an anarchic mix of live action and animation transporting kids from classrooms onto tall ships, deep inside worm farms, and back out through interstellar wormholes.

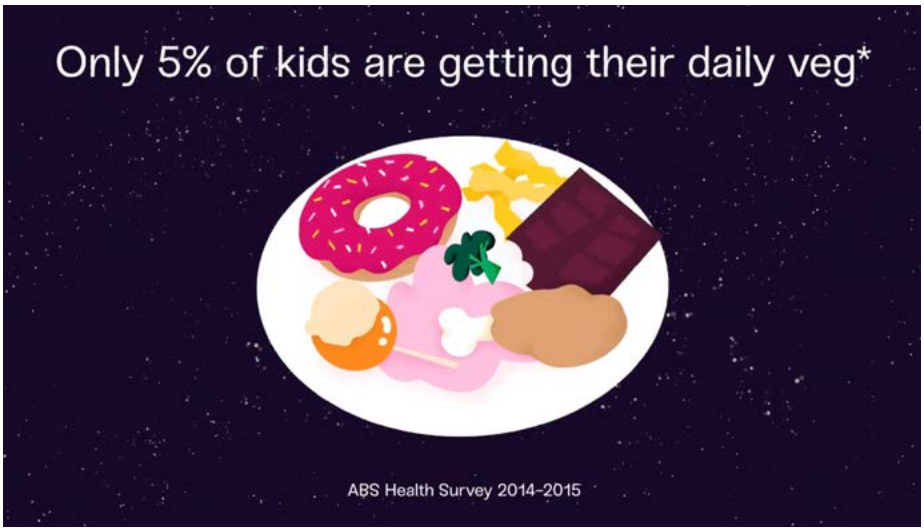
For the uninitiated the approach is certainly different to anything seen before, signifying a generational change in vegetable educational tools for kids, teachers, and parents.

As mushrooms now embark on their own Phenomenom journey, we are excited to announce a new addition to the ways children and teachers can interact with

the resources and learn more about fresh produce! A series of podcasts will be created to provide springboards for new and existing PDF lesson plans and activities. A new 5-7 minute webisode plus nine downloadable PDF teaching resources (with a focus on Australian Mushrooms and Australian Onions) will also be added to the existing resource bank of 25 webisodes and 50 PDF lesson plans.

All of these provide more opportunities for children to learn and connect with new foods in the classroom through curriculum-aligned resources, so that they seek to increase consumption of fresh foods at home. The program also works to further shape the language used in the classroom and at home to improve perceptions of fresh produce and enable kids to see that fruits, vegetables and mushrooms are not just important but are also delicious!

To find out more about the program, please take the time to visit the website at http://phenomenom.com.au.



Pictured Top: In this phenomenom clip, Chef George Calombaris Judges a Cooking Competition. Creator Alice Zaslavsky is on the far right.

I would like to think of this show like a salad. There are different vegetables in this salad, there is a dressing in this salad, and each of those vegetables represents a different texture within the show, whether that be an animation, or a skit, or even the different characters that we have cast for different kids. Each of them has something different to bring which means that whoever is watching it at home is going to find something they can relate to, and something that resonates to them.

We have got internationally renowned chefs, we have got Olympic athletes, we have got Brownlow medallists, we have got people who are going to make every single kid look up and listen, and that is all that I need, because as soon as they listen for a couple of minutes, they are going to be hooked. This show is great! It is funny! It is interesting! It is funtastical. You are going to love it.

Alice Zaslavsky

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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

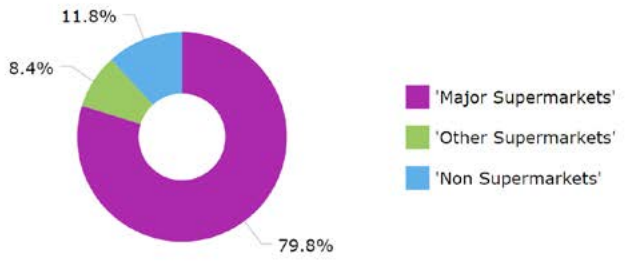
Mushrooms achieve strong **retail sales over 2018**

52 WEEKS ENDING 29 DEC 2018 | CHOOSE YOUR PRODUCT: MUSHROOMS | YEAR ENDING: 29 DEC 2018

RETAILER OVERVIEW

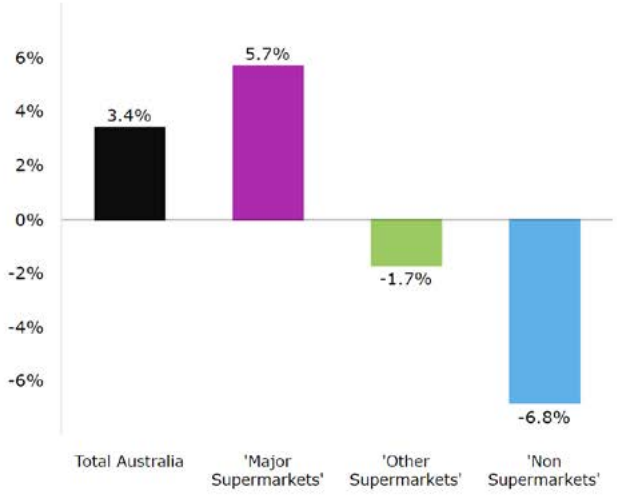
The dollar share of trade from major supermarkets was 79.8%. Dollar sales for major supermarkets rose by 5.7%. Non-supermarkets make up 11.8% of dollar share of trade and dollar sales were falling (-6.8%) .

RETAILER DOLLAR ($) SHARE OF TRADE



Source: Nielsen Homescan for the 52 weeks ending 29/12/2018 for the Australian market.

RETAILER DOLLAR ($) GROWTH



Source: Nielsen Homescan for the 52 weeks ending 29/12/2018 for the Australian market.

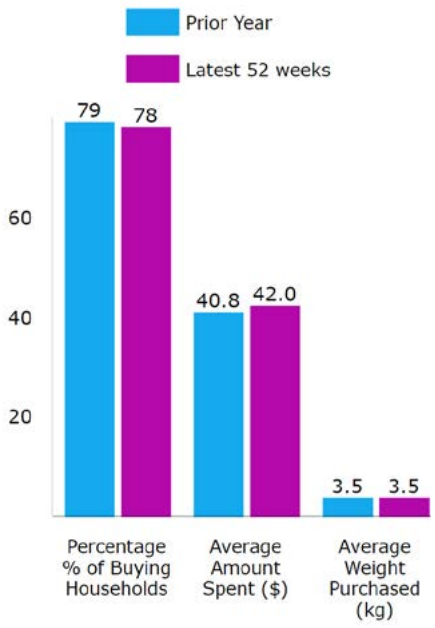
To measure the success of marketing campaigns, you need data, and one source used is Nielsen Homescan data. This information is gathered by global information and measurement company, Nielsen using a panel of consumers selected as representative of the Australian population.

And while you will often see an analysis of Nielsen Homescan data presented in this Journal some information is also available on the Harvest to Home website portal.

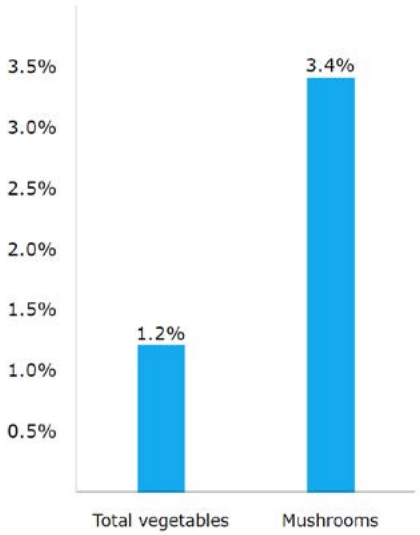
The Harvest to Home site is a Hort Innovation funded project providing up to date insights into market performance and shopping behaviour.

For the mushroom industry, this means being able to see at a glance the retail performance of mushrooms over a set time period. The following are the latest highlights for mushrooms for the 52 weeks ending 29 December 2018.

HOUSEHOLD BUYING BEHAVIOUR

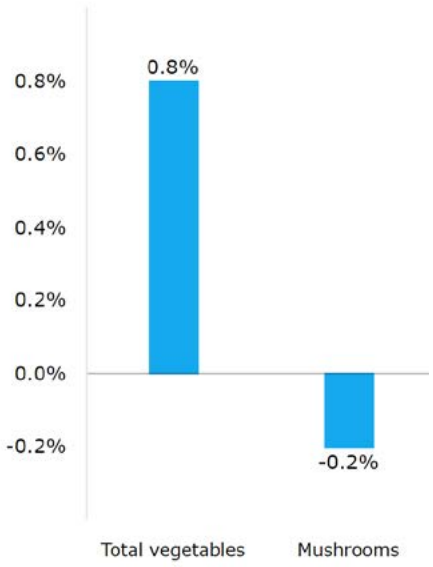


DOLLAR SALES ($) GROWTH VERSUS TOTAL VEGETABLES



Source: Nielsen Homescan for the 52 weeks ending 29/12/2018 for the Australian market. Copyright © 2019 The Nielsen Company.

VOLUME (KG) GROWTH VERSUS TOTAL VEGETABLES



Source: Nielsen Homescan for the 52 weeks ending 29/12/2018 for the Australian market. Copyright © 2019 The Nielsen Company.

To access Harvest to Home, go to www.harvesttohome.net.au

- Buying household percentage fell from 79% to 78%.
- The average spend ($) rose, from $40.78 to $42.01. In terms of dollar sales growth mushrooms outperformed total vegetables with a 3.4% increase compared to 1.2& for total vegetables.
- The average weight purchased (kg) remained unchanged.
- The dollar share of trade from major supermarkets was 79.8%.
- Dollar sales for major supermarkets rose by 5.7%.
- Non-supermarkets make up 11.8% of the dollar share of trade, and dollar sales were falling (-6.8%).

Hort Innovation

Australian Mushrooms: **Consumer Deep Dive**

1. The Story So Far: Previous campaigns have been successful in driving growth, but there's a need to better understand the customer to build a sustainable strategy.

In October 2015, a comprehensive research project was conducted to identify the big opportunities to drive growth for mushrooms. This research identified two main opportunities;

- **Primary Opportunity:** Empowering disengaged cooks to use mushrooms in a wide variety of everyday meals
- **Secondary Opportunity:** Helping highly engaged cooks incorporate more mushrooms in each everyday dish

The campaign developed off the back of this work has been very successful, with a tangible lift in mushroom consumption. To ensure long-term success, we have adopted a process of continual improvement – leveraging learnings from previous work to optimise future marketing activity.

To ensure we continue to drive growth of Australian Mushrooms, there is a need to develop a robust base of insight around our target consumers; understanding who they are, their approach and attitudes towards cooking, drivers of home cooked meals and where mushrooms fit in. This will allow us to develop a nuanced understanding of the opportunity areas & a clear roadmap on how best to unlock; with direct implications for messaging & targeting.

2. How We Identified Growth Opportunities:

A multi-stage approach to develop a rich understanding and validate growth opportunities.

1. EXPLORE

Exploratory research into the opportunity context

QUALITATIVE EXPLORATION

Qualitative research, consisting of **3 focus groups**, designed to explore our primary target consumer (less confident cooks); Providing **contextual depth**, developing a keen understanding of their **approach to cooking, mushroom attitudes** & **unmet needs** and interrogating reactions to the **current creative** to understand what **resonates**, **why**, and what we might need to **develop further**

2. ILLUMINATE

Sizing the opportunity & Validating behaviour

QUANTITATIVE SIZING

15-minute online survey of n=800 home cooks – covering both our primary & secondary targets. This stage is designed to **test findings** uncovered in the explore phase & **size key behaviours** relating to cooking, mushroom usage & media consumption to **build a robust picture** of our target mushroom consumers and **gain clear understanding on where the opportunity lies** & **how we can access**

3. What We Found - The Mushroom Landscape: There is a significant opportunity to increase contribution of those open to mushroom.

An overwhelming majority (87%) of consumers are open to purchasing mushrooms. However, only 60% of Australians had purchased mushrooms in the last 3 months. This affords us a significant opportunity to improve the penetration & purchase frequency of mushrooms amongst non-rejectors.

There is limited scope to bring mushroom rejectors into the category with taste (78%) and texture (40%) the main reasons for not purchasing. These are structural barriers that will be difficult for us to overcome.

4. Who do we target? Young couples (SINKS/DINKS) represent a growth opportunity, especially if they're less engaged in cooking.

To identify opportunities for growth, we need to consider the different needs & size of the segments.

Engaged cooks make up 36% of all cooks, but account for around half of all meals containing mushrooms. This group are confident cooks and love to adapt & experiment with new ingredients/recipes, with a wide variety of regular meals they know how to make. Engaged cooks tend to prepare more meals per week than their disengaged counterparts and 1 in 4 of these meals will typically contain mushrooms. They are also more affluent & more likely to be younger families.

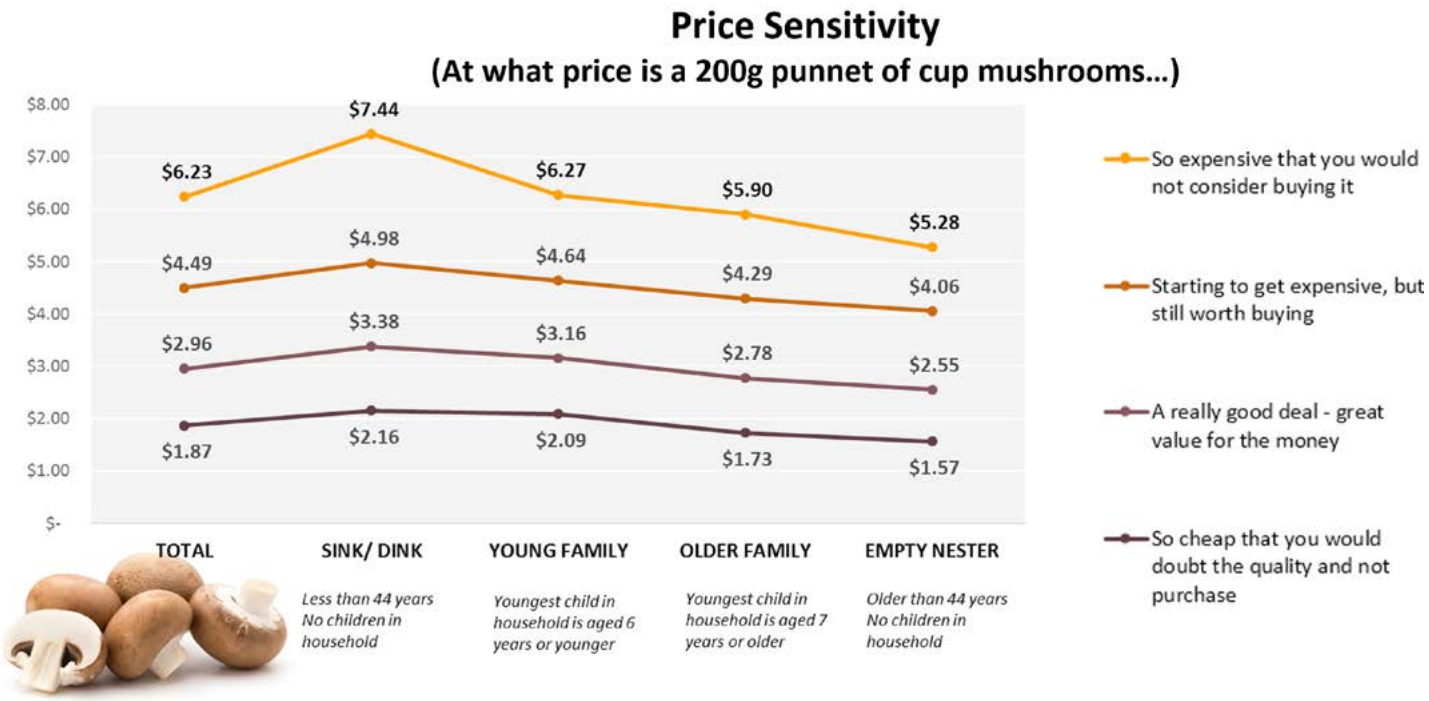
Disengaged cooks make up 52% of all cooks and are less confident when it comes to cooking. They try to minimise the time spent making weekly meals and keep things simple & easy. They are also more likely to look for meals/recipes that only involve a limited number of steps. They are likely to be slightly older & less affluent than the engaged. Although they are a significant larger group, they use mushrooms in less meals and so only account for 49% of all meals containing mushrooms.

"There is potential for an additional mushroom purchase occasion per week"

Both groups purchase mushrooms every second vegetable shop & only use mushrooms in around a quarter of all home prepared meals. As such, there is potential for an additional mushroom purchase occasion per week across both engaged and disengaged cooks.

The opportunity **skews towards SINKs and DINKs** (*defined as those less than 44 years with no children in their household*). They make up **36% of all home cooked meals** and are in the **process of establishing their repertoires**, making them **open to trying new recipes**. They are also the **least price sensitive demographic** due to their higher disposable income.

Number of Home Cooked Meals in a typical week (% Share of all Home Cooked Meals)	ENGAGED COOKS	DISENGAGED COOKS	TOTAL (% Share of Home Cooked Meals)
SINKS/DINKS	15,338,388 (16%)	19,657,978 (20%)	36%
Young Families	10,749,820 (11%)	9,731,829 (10%)	21%
Older Families	8,979,885 (9%)	11,027,237 (11%)	21%
Empty Nesters	9,640,018 (10%)	11,327,503 (12%)	22%
TOTAL (% Share of Home Cooked Meals)	46%	54%	

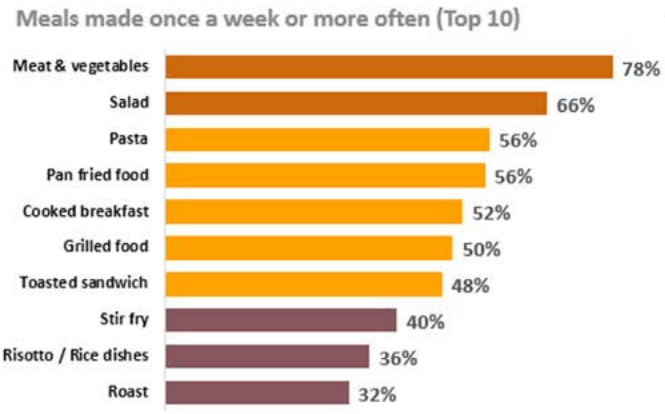


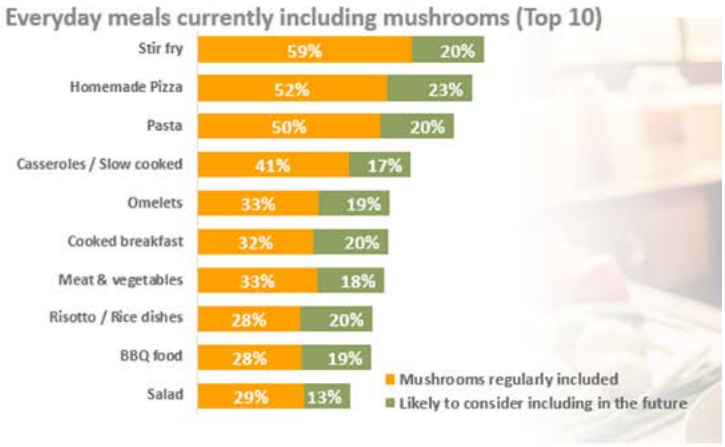
5. How Do We Grow? Opportunity to introduce mushrooms into existing & new meals with strong taste messaging.

"Taste is the number one thing cooks are looking for... and mushrooms have the potential to own this benefit in the vegetable category"

Taste/flavour is the number one thing cooks are looking for in home prepared meals. This aligns with the key drivers for including mushrooms in meals, with half of all cooks including them for the unique mushroom taste or to add richness/depth of flavor to the meal. From a messaging point of view, there is potential to own 'taste/flavour' in the vegetable category – with other vegetables speaking primarily to longevity, versatility & health.

There is a large opportunity to introduce mushrooms into existing meals for both engaged & disengaged cooks. To unlock, we should target the meals where mushrooms have a unique role & enhance the meal in a way that staple vegetables cannot. The heartland meals for mushrooms are stir fries, pizza, pasta, casseroles & omelets. However, there is potential to promote inclusion in more staple meals like meat & vegetables and pan fried food.





There is also scope to introduce new meals containing mushrooms into the repertoires of the engaged, with 45% regularly/often adding new meals into their repertoires. A multi-channel strategy is essential to facilitate this given the variety in approaches to meal planning.

WEEKLY MEAL PLANNERS

Tend to plan out the meals they're eating each week

WE NEED TO REACH THIS GROUP WITH RELEVANT MEAL INSPIRATION PRIOR TO ENTERING STORE

IMPROMPTU COOKS

Tend to only think about what they will cook for today and tomorrow

INSTORE SALIENCY IS ESSENTIAL TO ENTER THIS GROUPS CONSIDERATION SET

The key channels to provide meal inspiration for the engaged are friends/family, recipe books/sites & TV shows/cooking shows. There is a secondary tier of influences including; recipe bases, social media and supermarket catalogues.

6. What does this ultimately mean?

1. **Our fundamental strategy is sound** - Mushrooms continue to be under-represented in everyday meals for both engaged and disengaged cooks. Clear case for continuing to show how to incorporate mushrooms into existing meals with below tweaks to messaging & targeting.

2. **Lead with taste/flavour as the hero message** – Taste is the primary driver for including mushrooms for both the engaged & disengaged. There is potential for mushrooms to own this attribute in the vegetable category going forwards. Health & variety are important secondary messages for the engaged, and ease & affordability for the disengaged.

3. **Target a slightly younger audience** – SINKs/DINKs pose the greatest opportunity going forwards, with the chance to fundamentally change meal preparation habits for a lifetime. Young families are an appealing secondary target & are looking for new meals to incorporate into their existing repertoires. We need to focus on these groups in our media mix.

Educating Health Professionals **about Mushrooms**

The Australian mushroom industry has embarked on the next phase of efforts to educate health professionals about the benefits of mushrooms.

Above: To view a video introduction on the project please click on the image above or go to: https://vimeo.com/304328882

The Australian mushroom industry has embarked on the next phase of efforts to educate health professionals about the benefits of mushrooms.

Led by Dr Flávia Fayet-Moore from Nutrition Research Australia, the three-year project builds on previous work undertaken on behalf of the industry.

The objective will be to provide credibility and amplification of mushroom nutrition messages by educating health professionals about the health benefits of mushrooms through appropriate resource development and education activities.

Talking to Dr Fayet-Moore, a few things are immediately obvious including her enthusiasm for communicating the health benefits of mushrooms in new and innovative ways. And while education and communication are at the core of this project, the initial steps will be to examine the scope of the science and to develop a strategic approach to delivering that information.

Dr Fayet-Moore said a lot of the science is based on edible mushrooms that are not commonly consumed in Australia or focuses on mushroom extracts.

"Our first step will be to undertake a literature review to examine the science available.

"What we are looking for is the most robust science, and how the outcomes can be easily disseminated to health professionals."

Dr Fayet-Moore explained that once the literature review had been undertaken and assessed the project will move into the communication stage.

She explained that during the review process the project team would collate interesting facts with a view to translating the science to health professionals in a very engaging manner.

"Healthcare professionals are busy and do not always have the time or inclination to read scientific papers. Our approach will be to put in place a range of different communication tools such as newsletters and webinars, and to present information in an engaging and memorable manner."

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Above: Health professionals will be educated about the health benefits of mushrooms through appropriate resource development and education activities.

"By successfully engaging healthcare professionals will are looking to increase knowledge and awareness, and potentially lead to increased recommendations to include mushrooms as part of a healthy diet."

Every year of the project will have a different theme, with the first year focused on General Practitioners, the second year on dietitians and the final year directed more widely to all health professionals including naturopaths and allied health employees. As the project progresses, it's important that we continue to review uptake and opportunities, so this may evolve.

Dr Fayet-Moore said the project would tap into existing research during the first year, including the high prevalence of Australians with a vitamin D deficiency.

"With one in three Australians being vitamin D deficient, it makes sense to re-package and utilise existing research to show GPs that mushrooms can deliver real benefits in addressing this significant health issue," she said.

Dr Fayet-Moore said the focus of the second year would be on the unique nature of mushrooms, while the final year of the project will build emotional connections with the overall health benefits of mushrooms.

She said the project is one that will build over time, taking the research and the feedback from stakeholders to translate the work into actionable recommendations.

"In March we will commence audience sentiment research. Importantly this research will provide a benchmark on how much health professionals know about mushrooms at present and how they currently use this information."

"This sentiment research will also help us shape and communicate the health benefits of mushrooms and the type of recommendations we make to health professionals."

Dr Fayet-Moore said she was looking forward to working with industry and developing a wide range of appropriate health resources to continue to educate health professionals about the nutritional benefits of mushrooms.

To hear more about the project, please click on the following link to view a Hort Innovation video about the project.

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Put your foot down!

Ensure your foot dips are safe to use and fit-for-purpose

Warwick Gill
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Introduction

One of the key aims of on-farm biosecurity and Integrated Pest Management (IPM) programmes is to prevent exposure of the crop to mushroom pathogens. This is achieved through the implementation of three basic concepts: exclusion, containment and elimination. Mushroom growers are at an advantage over most other horticultural crops as they are able to control pest movement in and out of growing rooms and one of the simplest tools used to exploit this advantage is the foot dip.

All mushroom pathogens, irrespective of their biology, have one thing in common. At some stage, their infective particles (spores and hyphal cells of fungal diseases, vegetative cells of bacterial diseases and virus particles within mushroom spores and mushroom hyphal cells) will accumulate on the grow room floor (Fig. 1) as a result of standard cultivation practices (Table 1). Although Cladobotryum spores are spread by air currents, after firstly being dislodged by human activity, they will inevitably fall to the floor.

Foot dips play a dual role in a farm's IPM programme – they can be used to prevent the entrance of pathogens into new rooms and prevent their escape from old rooms. Foot dips also remind all staff entering or leaving a grow room that farm hygiene is an ongoing concern. But if a foot dip is neglected, or is positioned 'out of the way' or is difficult or dangerous to use, the staff will get the impression that hygiene is not considered important by farm management.

Figure 1 Accumulated organic debris colonised by Trichoderma on a grow room floor

Foot dips are not only for use by harvesters and management; they are very significant for disease treatment teams as they move from one room to another and also by visitors to the farm, particularly tradespeople and contractors who may have been to other farms.

Table 1 - How infective pathogen particles arrive on the grow room floor

Disease	Infective particle		
	Spores	**Hyphal cells**	**Bacterial cells**
Dry bubble (*Lecanicillium*)	Water splash Run-off Dead flies	Harvest debris Spot treatment	
Cobweb (*Cladobotryum*)	Water splash Run-off Harvesting Spot treatment	Harvest debris	
Brown blotch (*Pseudomonas*)			Water splash Run-off Harvest debris
Virus	Water splash Run-off Harvesting	Harvest debris	

Foot dips must be safe to use

In years past anyone working at or visiting a farm may have seen (and probably used) foot dips made by cutting the bottom off a 20-litre chemical container. These footdips were often loaded with a coarse salt that rotted footwear and eroded the steel uprights that supported the shed roof. Sometimes there was a scrap of filthy filter fabric in the bottom to wipe the soles of boots on, hiding under a layer of casing soil and mushroom debris floating in a dishwater-grey disinfectant solution.

More often than not, the sides of the foot dip were so high that you had to lean on the wall for support while you stepped over the side and into the sanitiser. Difficult to maintain poise when carrying a box or two of premium product. When you were at your most vulnerable, the foot dip took off and skated across the floor taking one leg with it, leaving you hanging on to the wall and with one foot firmly on the floor, doing the splits, surrounded by now slightly less than premium product... fun times.

The three main ingredients in the homemade 'foot-dip-recipe-for-disaster' (Fig. 2) are:

- sides too high
- a painted or polished concrete floor
- using a sanitiser which is slippery

If you decide to make foot dips out of a 20L chemical drum, be sure that the sides are as low as possible – the foot dip needs only to cover the soles of people's footwear and the inclusion of a spongy material in the bottom as a sanitiser reservoir can help lower the sides further. Cover the bottom of the foot dip with rubber matting or at least attach squares of rubber to the corners, which will help stop the foot dip sliding across the floor. Beware that spillage onto a painted or polished concrete floor can cause a significant slip hazard, particularly if the sanitiser contains a surfactant. We are increasingly aware of our obligations to staff safety and must use foot dips that are safe to use. Likewise, we have an obligation to maintain our on-farm biosecurity so foot dip design must not be a barrier for staff to use them.

Foot dips must be fit-for-purpose

Foot dips come in a range of shapes and sizes and not all designs are suitable for all applications on the mushroom farm. One foot dip model commonly available has two shallow shoe-shaped reservoirs with brushes built into the bottom of each reservoir and detachable brushes on both sides of each reservoir (Fig. 3a). The brushes are designed to remove dirt from the soles and sides of the footwear. While practical for low volume traffic such as outside a newly filled room that may be inspected sporadically by growers and supervisors, it is not suitable for high traffic volume areas such as a grow room on peak harvest day where many staff are going in and out. Because it requires people to concentrate on stepping into the shoe patterns and the foot dip itself is small, it will more likely be stepped over or pushed out of the way. On tray farms, there is no chance that trolley wheels (Fig. 4) could be passed through this type of foot dip. This design is easy to maintain as the sanitizer can be visually checked for organic contamination, the foot dip washed out and then replenished.

Left: Figure 2 - Foot-dip-recipe-for-disaster and not much use on a peak harvest day.

Below: Figure 3-Different styles of foot dips must be fit-for-purpose.

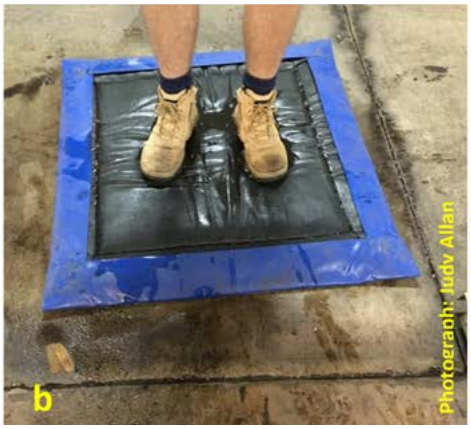

Figure 4: so many wheels.

Figure 5: An unused and neglected foot dip.

The second design (Fig. 3b) is more appropriate for higher volume traffic and consists of a sponge pad reservoir covered with a porous material that can be used to wipe the soles of footwear. Sanitiser is forced out of the pad when pressure is applied and treats the sides of the footwear. While this design is more likely to be used by staff, it would not be conducive for passing picking trolleys or wheeled box carts over it as the centre of the pad is raised above floor level. This design prevents direct gross organic contamination of the sanitiser solution, but emptying, cleaning and replenishing is more difficult.

The third design (Fig. 3c) consists of a large shallow reservoir lined with rubber brushes to clean boot soles. The sides have a very low profile and are shaped to facilitate wheeled equipment going through them. This design is more practical to consistent use in high volume traffic areas and for cleaning wheels and can easily be inspected, cleaned and replenished.

Foot dip maintenance

The two main factors which reduce sanitiser efficacy are the presence of organic material (casing, compost mushroom debris) and water (dilution). To maintain effectiveness, foods dips must regularly be emptied, cleaned of organic material and replenished with fresh sanitiser diluted according to the manufacturer's instructions. The sanitiser used must be one of the products registered for use on mushrooms farms by the APVMA and the label must list it as appropriate for use in foot dips. We often hear of people 'topping up' foot dips. While this may be a cost-saving measure, this acts as a dilution. The depleted sanitiser in the foot dip will have very reduced activity compared to fresh solution. A foot dip containing half the volume of depleted solution and half the volume of fresh solution will have less activity than a full volume of fresh solution. Please note that it is the responsibility of the farm to ensure disposal of spent sanitiser is done in accordance with local EPA legislation.

Replenishing foot dips costs money, but if they are not replenished regularly, they become ineffective and a waste of money and even a liability. In research performed on foot dips on a piggery, it was demonstrated that if a foot dip was used more than ten times, footwear became infected from the foot dip (Amass et al 2000).

If a foot dip is not being used, it is wise to empty it, clean it and put it away. Neglected foot dips pushed into a corner when not needed can become a breeding ground for pests and diseases (Fig. 5).

Wheeled vehicles

Not only feet, but wheeled vehicles are capable of introducing pathogens into grow rooms and other sensitive areas. On tray farms and block farms in particular, new crops are carried through the facility by forklift to fill a clean room, often passing old and diseased rooms multiple times during the operation, picking up debris and pathogens each time and delivering them to the new room. By introducing a sanitising mat across the entire grow room door, the forklift must cross over it each time it enters and leaves the grow room, sanitising the wheels each time. Also, staff cannot avoid walking over the foot dip and it is easy to roll trolleys over it. Previously PDMS has advocated the use of carpet off-cuts, but one enterprising farm has laid synthetic grass at the vehicle entrance to the growing facility. Being plastic, organic material does not collect as it does in the weave of a carpet off-cut and it is easier to hose off and replenish.

Importantly, the mat must be wide enough to stretch entirely across the doorway (Fig. 6a) and long enough to accommodate at least one revolution of the largest wheels. There are two ways to do this. For non-mathematicians, the first way is to drive the forklift up to the leading edge of the mat and mark the position on the tyre (Fig. 6b). Then drive the forklift across the mat to the

Figure 6 Determining the correct length of sanitiser mat by marking the wheel a) a synthetic grass mat laid across the vehicle entrance to the growing facility. The sanitiser-soaked mat is wide enough to fit across the doorway so that all foot and wheeled traffic must pass over it b) marking the tyre where it contacts the mat (arrow) c) after the forklift has crossed the sanitiser mat (yellow arrow), the chalk mark (white arrow) indicates that the tyre has not completed one revolution. The mat is about 1 metre too short to be effective.

far edge (Fig. 6c). If the mark has not completed a full revolution and has not come into contact with the mat again, as it has not done here, then the mat is too short. In this case, it appears to be about 1 metre short.

For those more comfortable with numbers, the length of the mat should be at least equal to the circumference of the largest wheel (Fig. 7). The formula to measure the circumference of the wheel is $2\varpi r$.

Example: if the wheel measures 70cm in diameter, then the circumference of the wheel and the minimum length of carpet you will need is 70×3.14 = 220cm or 2.2m.

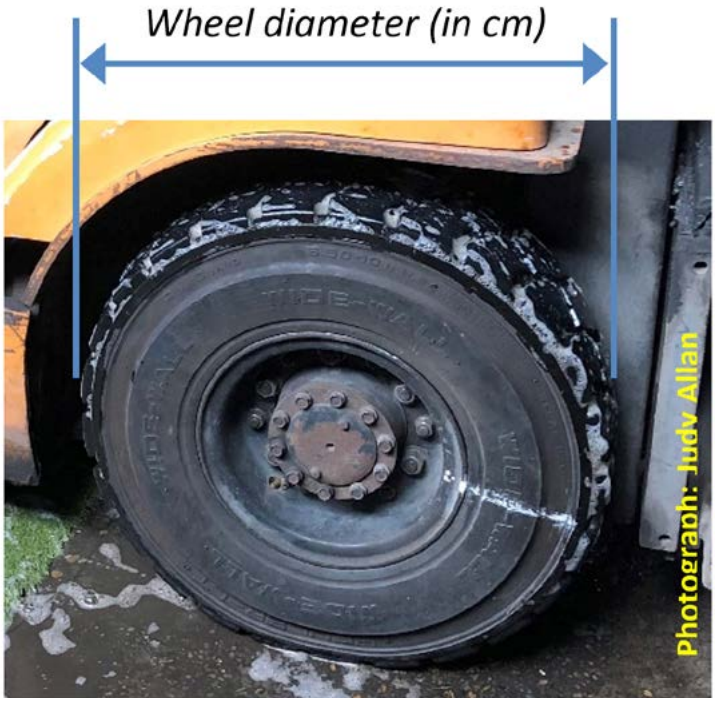

Figure 7: Determining the correct length of a sanitiser mat by measuring the wheel.

Suggested reading

Amass SF, Vyverberg BD, Dowell CA, Anderson CD, Stover JH (2000) Evaluating the efficacy of boot baths in biosecurity protocols. Swine Health and Production 8:169-17.

Cole PS (2002) Integrated pest management in mushroom production. Chapter 2 in: Mushroom Integrated Pest Management Handbook. Penn State University.

Fletcher JT, Gaze RH (2008) Mushroom Pest and Disease Control – a Color Handbook. Academic Press.

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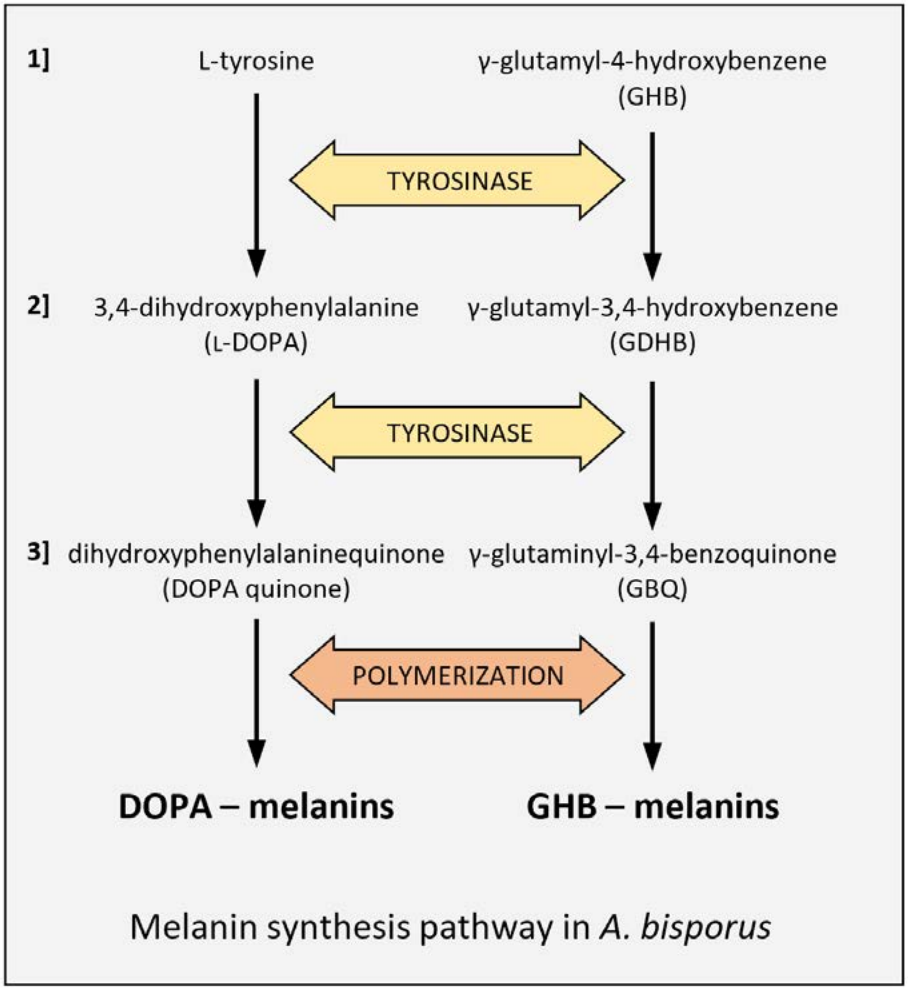
Why do mushrooms **turn brown?**

By Warwick Gill, Tasmanian Institute of Agriculture, University of Tasmania, Hobart



Melanin synthesis pathway in *A. bisporus*

Mushroom browning is the greatest cause of quality loss the mushroom grower will have to contend with. Of the major desirable qualities considered by the mushroom consumer, colour is the top ranked attribute.

How mushroom colour presents on the retailer's shelf will often determine if mushrooms are purchased as brown discolouration is perceived as an indicator of spoilage or of microbiological deterioration.

Mushroom browning is the result of the enzymatic oxidation of phenolic substrates by tyrosinase, leading ultimately to the formation of darkly pigmented melanins (refer to box). The two predominant phenolic substrates in Agaricus are L-tyrosine and GBH (1). Tyrosinase, with the addition of extracellular molecular oxygen, oxidises L-tyrosine to L-DOPA and GBH to GDBH (2). Tyrosinase again oxidises these intermediates further to slightly pigmented DOPA quinone and GBQ (3). The quinone intermediates then undergo numerous polymerization reactions to form melanins. The phenolic substrate GBH ultimately forms GBH-melanins while L-tyrosine ultimately forms DOPA-melanins. The DOPA-melanins are a diverse group which display a variety of pigmentation including purple, red, orange, yellow and brown, depending on the polymerization reactions they undergo.

Agaricus bisporus is a white button mushroom. While it is white, the tyrosinase enzyme and the phenolic compounds are separated by cellular membranes; tyrosinase is loosely bound to organelles within the hyphal cell cytosol and the phenolic substrates are compartmentalized within cell vacuoles. Only when the separating membranes are broken down do the enzyme and substrates come together, react and begin melanin formation. Membrane disruption can be caused by physical damage leading to bruising, physiological aging leading to the darker colouration of more mature mushrooms, microbial attack such as bacterial blotch and fungal spotting, insect infestation and senescence. Any, or a combination of these factors, may lead

to expression of postharvest browning. While the full story of mushroom browning is yet to be discovered, the brown blotch organism, Pseudomonas tolaasii, is being applied as a major investigative tool. The toxin produced by P. tolaasii, tolaasin, permeabilises membranes allowing phenolic substrates and tyrosinase to interact and produce the brown melanised blotch symptom. In the case of microbial attack, the formation of melanins protects the damaged tissue by sealing off the wound and forming a barrier to pathogen penetration and then by polymerizing both the hosts proteins and the toxic compounds produced by the pathogen to render the toxins inactive.

Mushrooms are generally more susceptible than other vegetables to browning as they lack a waxy cuticle which protects other fruits and vegetables from microbial attack and physical damage. Tyrosinase is located only in the mushroom fruitbody and is concentrated in the skin but also occurs to a lesser extent in the gills and stipe. Consequently, browning is largely confined to the skin. GBH, one of the most abundant phenolic substrates, is only found in Agaricus and is only formed when mushrooms are grown on compost.

Optional reading

Link to selected articles

tia
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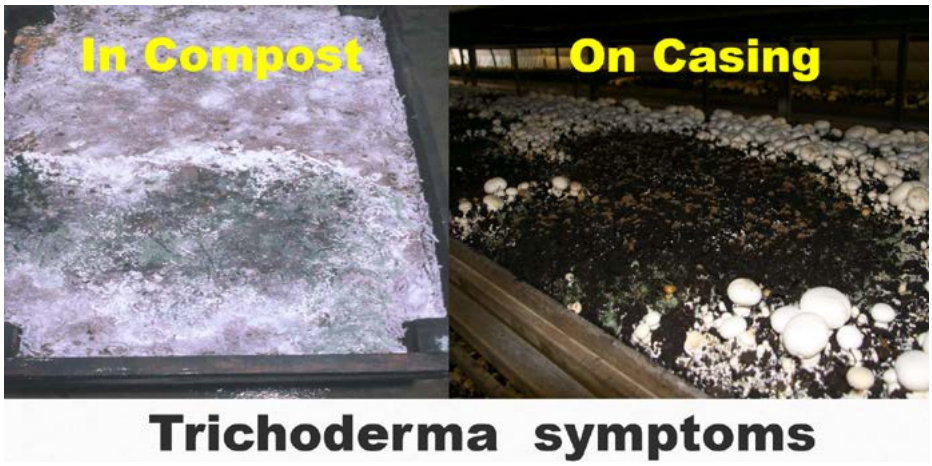
The design and operation of mushroom facilities in relation to **Trichoderma & Virus X outbreaks**

A good understanding of the hygiene requirements and the implementation of appropriate operational procedures are two of the keys in dealing with Trichoderma and virus X outbreaks, according to Dr John Burden.



An internationally recognised expert on pest and disease management, United Kingdom-based Dr Burden recently addressed the Australian Mushroom Growers Association conference in Sydney covering the topic - The design and operation of mushroom facilities in relation to Trichoderma and Virus X outbreaks.

Dr Burden provided a hands-on, practical discussion on the issue, highlighting a number of case studies that resulted in crop failures, that he said with foresight should not occur again.

He explained that Trichoderma was a fast-growing and aggressive coloniser with sticky spores easily disseminated by flies. Once this is present in the crop, the initial infection grows at the rate of centimetres per day.

In comparison, he said, Virus X is a naked, double-stranded RNA virus that as well as being spread by very small fragments of mycelium, travels via cytoplasmic streaming through the mushroom mycelium network. It is an insidious virus and requires barriers to infection magnitudes higher than have previously been necessary for any other mushroom disease.

Dr Burden explained there are now 33 species of Trichoderma related to the mushroom industry and said while not all strains are aggressive, some can cause severe damage to the crop if allowed to become established.

"Many Trichoderma sp require light before they start sporing, so infection often cannot be seen in material leaving a tunnel."

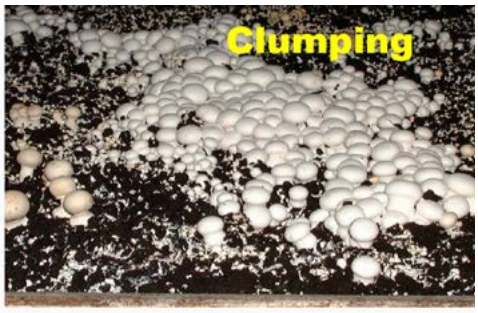
"However, at pinning large bare patches can often be seen as pins fail to develop, often along with the giveaway sign of Trichoderma with the associated population of mites accumulating on the surface."

When it comes to Virus X he said, it is a totally different concept of disease control.

He introduced a "threshold" concept, pointing out that disease can be present on the farm and if the concentration of the virus in the mushroom mycelium is below the threshold level no symptoms will be seen.

"If cyclic infection patterns become established either in the compost yard or on the mushroom farm the virus titre in the unit can rise dramatically and symptoms will become apparent."

The fact that the symptoms of Virus X can be variable and not as distinct as Trichoderma, poses a problem, when diagnosing the disease, he said.



"During spawn run or case run everything looks normal, however when it comes to the pinning stage things can change quickly with pins in certain areas not developing resulting in bare patches with healthy mushrooms around them."

Another symptom he said is clumping, where the mushrooms develop far too close together, and it is impossible to pick them, or to pick quality mushrooms from them.

Dr Burden detailed the range of different symptoms including apparently good quality mushrooms that after harvesting show premature opening. Another symptom is that of brown mushrooms, where individual mushrooms in clumps of perfectly white mushrooms simply go brown, or where a whole crop can be just "off-white", reducing yield.

He said while modern laboratory techniques are very accurate in indicating the presence of Virus X in the mycelium, further research is required to marry symptoms to specific bands on the plates.

He stressed that in transmission terms, only very small quantities of infected material are needed to spread both Trichoderma and mushroom Virus X in bulk handling systems."

"It is easy to appreciate how the diseases can spread by spores and mycelial fragments, contact or by poor hygiene, but this relatively new concept of spreading disease by cycloplasmic streaming within the mushroom mycelium introduces a totally new concept of disease transmission to the industry."

He said work by Helen Grogan at Teagasc showing the very small amount of tissue material necessary to spread the infection alarmed everybody. Her research showed the virus could spread the depth of a shelf within two days so that contamination can be rampant within a tunnel or a growing house during spawn and case run.

Very small quantities of material can spread the infection

"As with all diseases, the earlier a crop is infected, the worse the symptoms. Infection in bulk handling systems can slash yields and take many months to recover production to pre-infection levels."

"If scant care is taken in controlling these diseases, losses can and will occur. It goes without saying that prevention is always better than cure." He cited some farms in the United Kingdom that had never recovered from the initial attack of Virus X.

He said that once the infection is allowed to get into a tunnel complex or a mushroom farm, there are many additional ways that it can be spread, particularly if complacency is allowed to creep into routine operations.

"Procedures must be checked regularly, and attention to detail is necessary at all times. A training program for all new and existing staff is always beneficial."

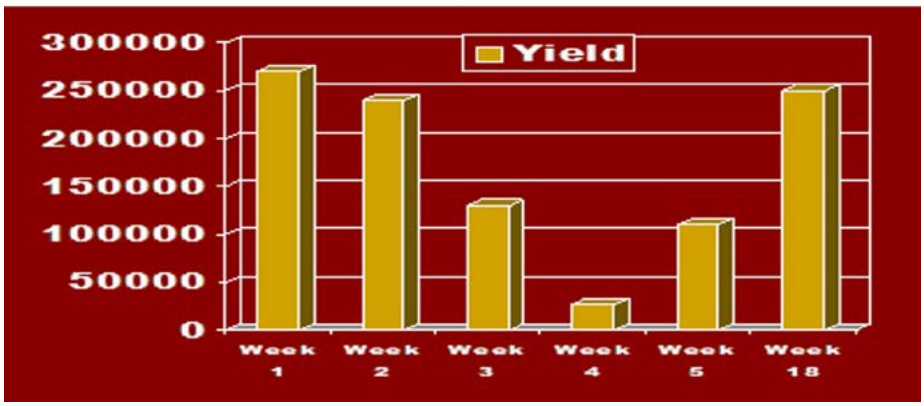
"All phase 2 and phase 3 facilities should be designed to provide positive pressure with adequately filtered air in the sensitive areas."

"Infection can and will occur if the integrity of the unit is broken through weak door seals or badly fitted air filters."

"Any breach on the negative side of the system will draw unfiltered air into the system causing contamination. A similar breach on the positive side of the fan will leak potentially infected material into the ambient surroundings."

Similarly, in growing houses, if the positive pressure is not maintained in the roof space, cyclic infection patterns will develop between the cropping houses and the new houses.

The impact that a disease can have on production and the extended recovery time



Dr Burden said operations producing phase 3 compost in a series of tunnels face a potential issue as fans run at different speeds throughout the process and large pressure differentials can occur between units, providing a potential route of infection between tunnels if they are not intact.

"With the high-pressure present in modern tunnels, leaks can easily develop, and depending on the design, issues such as single walls between individual tunnels, inadequate door seals, drip trays that are not trapped, and poor ductwork can easily spread infection between subsequent compost batches."

"Where construction includes a gap between each tunnel, any leaks in the wall will simply dispel to the atmosphere. But, if the foundation floor continues along the set of tunnels, or in older structures where joint move or cracks develop, infected particles can move from one tunnel to another via these flaws."

"The only way to ensure this does not happen is to have a break between the base concrete level."

Dr Burden explained that good quality HEPA filters would certainly keep spores and mushroom Virus X out of the system. However he stressed the need for them to be installed and maintained correctly.

"Effective prefilters are very important and if changed regularly will dramatically extend the life of the main filter."

"Unfortunately, even newly installed systems are sometimes not installed correctly. To be effective filters have to butt very firmly onto the neoprene gasket in the housing to form a good seal. When filters are slotted into the duct, there should be no gaps; otherwise, when the fans draw air, the air will take the easiest route and by-pass the filter."

He explained that damaged ductwork was also an issue that could destroy the integrity of the system.

"Gaskets between ductwork should be examined regularly, and clips on the flexible joints must be tight at all times. Water traps must contain water otherwise they will suck air into the system -especially if on the negative side of the fan."

"In both tunnels and growing rooms the heating, cooling batteries and air dampers are all potential weak links, especially if they are positioned on the negative side of the fan, sucking air into the system.

Dr Burden said maintenance staff must be made aware of the importance of the integrity of the ductwork and understand the role of the filtration system in keeping disease out.

"Bolts and rivets and flexible joints need to be checked routinely, and holes should not be drilled in ductwork."

Filters need covers over the location holes

"It is common to find holes in ductwork where bolts were once inserted, and the holes remain open. These holes must be blocked or capped."

"I have seen many farms spend a lot of money and effort on filtration, but obvious flaws in the system negate a lot of the effort and money spent."

Dr Burden said dirty machinery was an obvious route of inducing infection and suggested if basic routines were bypassed and not checked, that infection would occur.

"Most phase 2 and phase 3 facilities superficially look very clean, but if in-depth searches are made of less visible surfaces, you can often find areas needing scrutiny."

"Spawn and supplement hoppers handle nutrient rich materials which are ideal to foster the growth of microorganisms. It takes a very small amount of materials to transmit these two diseases, so it pays to be thorough."

Dr Burden said the United Kingdom was the first country to draw attention to the effects of Virus X on the crop.

"At the time many facilities in the UK used in phase 3 production were woefully inadequate at being able to contain the spread of the disease in phase 2,3 and growing facilities."

"Many cyclic routes of reinfection were present, so titre levels of the virus were able to quickly increase."

He suggested any farm wishing to develop phase III facilities should studying the design flaws in these UK farms and learn from the very basic errors made.

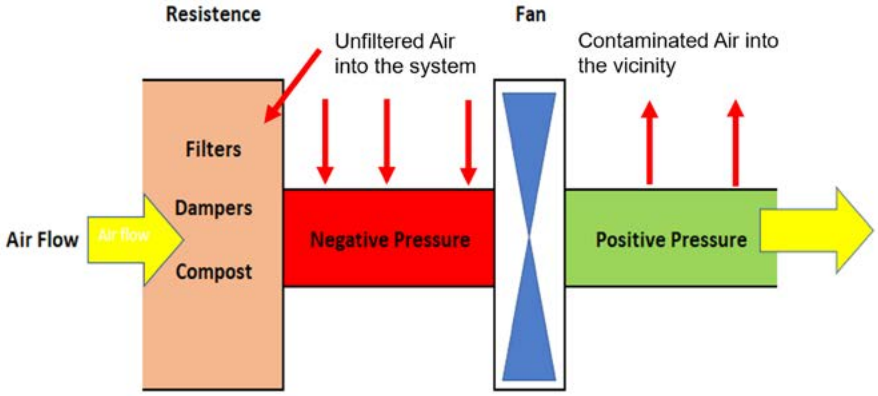
"When bulk pasteurisation was first introduced it was thought that the phase I compost offered the most serious contamination threat, but now the fully colonised phase III compost is considered potentially far more dangerous."

Concerns over establishing cyclical infection routes now take precedence and rightly so, because If cyclic routes are present disease levels can rise quickly, he said.

Dr Burden suggested that personnel were an obvious route for transmission in both tunnel complexes and mushroom farms.

"Being able to separate dirty from clean operations and the staff that work in them is vital, and personnel from dirty

Positive and Negative Pressure in systems



areas should certainly not enter clean areas."

"Pre-crop houses should be out of bounds for harvesting staff, and communal areas need thorough routine hygiene procedures and should only be accessed in clean clothing, not working clothes or shoes."

He said when phase 3 material is emptied or moved, there was an obvious enormous potential to spread infection, both within that batch of compost and into other batches if there are flaws in the tunnels, spawning halls or growing houses.

"As the compost passes through the winch, the compost is broken up and tumbles from conveyor to conveyor before being spread in layers on the trailer and into the growing house. As a result, the emptying hall is filled with spores of dormant composting organisms, any green moulds that might be present, plus masses of tiny fragments of mushroom mycelium possibly containing Virus X."

"The hall should be under positive pressure and ideally include filters of some kind - either a wet spray or a dry filter fabric - or put through a biofilter on the exhaust. The relatively common approach of venting straight to atmosphere considerably increases the infection pressure on the surrounding buildings."

Dr Burden suggested mixing compost, and growing facilities was not a good idea.

He said the transport of compost is another major potential risk area.

"Most companies realise the importance of hygiene and have very strict procedures and facilities to wash both the inside and the outside of vehicles when returning from farms. This is very important for both compost and casing vehicles as they often stand for hours outside the vents of growing houses that could be emitting disease propagules.

"Vehicles returning from a contaminated farm could easily re-infect a production unit if precautions are not taken. Effective vehicle washing facilities should be designed into units."

Dr Burden said building designs should incorporate filters on the exhaust of the growing houses and encompass facilities to wash down equipment effectively and take the wash water away from the area.

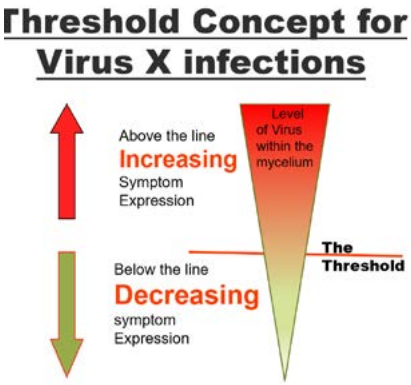
"Fundamentals apply to all disease situations and hygiene procedures are of paramount importance to any intensive production unit."

"Creeping variance and maintaining high standards week after week along with the much-used phrase 'attention to detail' is very important in keeping diseases out."

He suggested quality raw materials are a very good barrier to keeping some infections out of the mushroom crop. If the crop is nourished well, on good quality, well-balanced compost it helps the mushroom to withstand onslaughts from other competitive organisms.

"An unbalanced compost or supplement can aid the growth of certain diseases. While spawn should not be a source of Trichoderma, the very high carbon content of the grain is an ideal food source for Trichoderma to grow on and often is the focus of initial infections. Spawning and supplementation hoppers, blocking and filling machines need to be designed to dispense the compost and spawn evenly throughout the mass of the compost to reduce this risk."

"Unfortunately, because mushroom Virus X travels within the mycelium of the mushroom, compost quality will not influence the spread or the symptom expression within the crop."



"Any sub-optimal parameter during the whole growing cycle can predispose the crop to infection, favouring the growth of other organisms over that of the mushroom mycelium."

Dr Burden stressed that effective environmental control is always important when growing mushrooms.

"When phase 3 compost is refilled into the shelves, excessive heat generation can be a clear indication that the spawn run is immature, or indeed the presence of another organism fighting against the mushroom mycelium in the compost."

"Adequate heating and cooling capacity are important, maintaining optimum temperature for the growth of the mushroom mycelium should be of paramount consideration at all times during spawn run and case run."

Dr Burden suggested that when planning new facilities, dirty and more potentially risky operations should be positioned away from cleaner areas.

"While this may not be possible on existing sites, the positioning of growing rooms close to composting facilities, casing storage or preparation areas is foolhardy. Likewise, positioning phase 2 and phase 3 facilities close to growing facilities should be avoided at all costs and ideally composting, and growing facilities should be conducted on separate sites."

Positioning of facilities within a farm

Phase II and III facilities close to growing houses

Stumps and waste compost holding areas close to other sensitive areas

He said effective disease control is also reliant on quality staff, and staff training requires due consideration.

"You can have as many effective written procedures as you like in any organisation, but you need the commitment of the staff to follow the plan, for them to be effective."

When considering new developments, Dr Burden suggested taking site-specific advice from impartial experts.

"Salespeople have their own agenda, but there is often more than one plausible solution to every situation, and it is worth listening to all options, before taking a decision."

He cited the example where he was called to help a facility after it had been built.

The facility had a single 300 ton phase 2 tunnel when only 70 tons were required for the first phase. The tunnel took up to five days to empty, exposing the compost and opening the opportunity for spreading disease. The design of the floor had two fans – with two air filters and two dampeners - feeding into the one manifold that could never be balanced. The design was simply wrong, he said.

Dr Burden said farms are often aware of the hygiene requirements and have procedures in place, but these procedures are simply not followed on many occasions.

"Management needs to ensure the operation procedures are carried out consistently in the manner they have been instructed."

"With good positive pressure, the correct filter and well-designed systems you can control both of these diseases," Dr Burden said.

Design and sizing of facilities

hotograph of 300 tonne phase II tunnel with
vo fans and dampers into the same plenum

Questions:

Traditionally a lot of growing houses were cooked out with steam. Would you suggest any processes, such as ozone or anything for decontamination, or do you think the steam is the only way?

Dr Burden: Steam is very effective and should kill all surface organisms, and if you hold the temperature for a long enough period it will kill organisms in the compost as well. If you have a virus X infection, you do need to cook out, or you run horrendous risks. There are farms in England, and large farms that are not cooking out any longer, but they are basically on the two-flush system, and their disease procedures are very good. In essence, if you have a nasty disease, steam is very effective at stopping cyclic infection patterns developing.

The success of the European Mushroom Industry

When it comes to Agaricus mushrooms, Europe is the largest producer, according to Sylvan European Managing Director, Mel O'Rourke when he compared trends in mushroom production over the last 30 years.

Major European Producers of Agaricus

Approx Yearly Output in '000 tonnes

	1988	1998	2008	2018
France	195	150	110	105
Netherlands Belgium & Germany	145	190	230	250
UK	110	95	50	60
Ireland	55	70	75	75
Poland	55	90	180	310

Above: The adoption of Dutch Technology was one of the success factors for the growth of the Polish industry.

Mr O'Rourke was one of the keynote speakers at the 2018 Australian Mushroom Growers Association Conference in Sydney.

He walked delegates through the current situation in Europe with regard to production, outlining that countries like Poland, Russia and Turkey were in expansion mode, while others like Belgium, Holland, Hungary, and Spain are seen as mature and France, Germany, Italy, Ireland and Britain were consolidating or slowly declining.

In the case of Ireland, he said the industry had already been impacted significantly by Brexit, with the currency shrinking by more than 10% since the British referendum compared to the Euro.

"Currency and the value of Sterling compared to the Euro has had an enormous impact as Ireland is totally dependant on the UK market.

In 1988 production was around 55,000 tons and the industry is now producing 75,000 tons. "The difference is that in 1988 there were 850 growers, serviced by 14 compost yards, compared to today with about 56 growers and just three compost yards."

Mr O'Rourke discussed the French industry which was slow to change and has dropped from a leading position in 1998 to a declining industry producing just over 100,000 tons currently, with 85,000 tons going directly to processing.

He said the Dutch had embraced innovation and has become the world leader in terms of equipment and technology.

Spain was slow to adopt phase 3 compost, but this has happened over the past five years, and as a result, the industry continues to expand. In comparison Italy has seen little or no investment in Agaricus, making it a difficult place to do business, he said.

Mr O'Rourke explained the development of the European Union (EU), bringing

Production Cost Comparison

		IRELAND			NETHERLANDS			POLAND		
		2008	2018	Change	2008	2018	Change	2008	2018	Change
Compost Cost Per Tonne	AUD	256	349	+36%	194	202	+4%	171	233	+36%
Averge Yield Per Tonne	KG	300	370	+23%	315	330	+5%	280	350	+25%
Selling Price Per KG	AUD	2.73	2.64	-3%	1.94	2.25	+16%	1.72	2.09	+22%
Variable Cost Per KG	AUD	2.25	2.39	+6%	1.81	2.03	+12%	1.43	1.54	+8%
Gross Profit Margin	%	+18%	+9%	-46%	+7%	+10%	+46%	+17%	+26%	+56%

together Germany, Netherlands, France, Belgium, Luxembourg and Italy in 1957, further expanding to include the United Kingdom, Ireland and Denmark in 1973, enlarging again in the 1980's and then through the early 1990's with the reunification of Germany.

The big change, particularly for the mushroom industry he said, was the inclusion in 2004 of the western or central European countries such as Poland, Estonia, Latvia and Lithuania.

"The big thing for the mushroom industry was that Poland acceded to the EU. With 38 million people in Poland, the country benefitted from the support of the common agricultural policy which effectively took taxes from the Germans, British and the Dutch and divided it up among the new entrants.

"When Poland entered the EU, it was producing between 80,000 and 90,000 tons of mushrooms, they had an export quota of 38,000 tons that it could sell to the EU. When it joined, that quota disappeared."

Mr O'Rourke said the critical factors for success for Poland were that it adapted the Dutch technology; they had the raw materials through cereal production; there was plenty of labour with unemployment at over 20%, and they had an independent currency.

"Among all those factors the most important was that they were hungry for success, and as a result, the industry has expanded rapidly and become quite efficient."

"Among the European countries, Poland has scope to expand even further, with improvements to compost productivity and growing efficiency and through optimising labour performance."

Mr O'Rourke outlined that in 2018 the gross profit margin in Ireland was around 9%, with the Netherlands at a similar figure. In comparison Poland was around 26%, giving it plenty of room to expand and develop further, he said.

He said that labour availability is the number one concern for the mushroom industry in Europe.

"For all the time taken in growing and composting and in all the other issues in a mushroom business, labour and the management of labour is what takes up the most time."

"Recruitment, training, the replacement of labour are all things that eat away at the available time, and labour is an area that can have the biggest impact on profitability."

"Once you get mushrooms on the bed, pickers have a big influence on profit with a difference of up to 10% in yield between pickers. And when you lose a picker, you must recruit a new picker and then train them.

He explained that in Ireland the cost of replacing a picker was determined to be around €3,000, making it a significant cost to the business.

"The single biggest challenge for the next decade is recruitment, particularly as most young people don't want to work on Saturdays or Sundays and mushrooms grow over the weekend."

He said the extent of the issue was such that one customer from Hungary was considering going to Vietnam to bring pickers back into Europe. "The initial cost, and the subsequent cost of pickers not working out, would be significant."

Mr O'Rourke was enthusiastic about the Australian research that has commenced using virtual reality to train mushroom pickers.

"If you could adopt this virtual reality training into the recruitment process it could be a big improvement to the industry. Because people will need to be recruited from outside the European Union to have a stable mushroom industry in the future."

Picker Training & Retention

Mr O'Rourke pointed to future improvements for the industry, saying that "any task that did not draw on human creativity or interpersonal skills was a candidate for future automation".

Automated harvesting or watering by drones were two such possibilities put forward for consideration.

In the marketing area, Mr O'Rourke said there had been some promotional activities in Western Europe aimed at cutting through to consumers with health messaging.

"Australia has set a very high bar in terms of promotional activity and in comparison, there is a relative lack of promotion throughout the EU. Australia is talking of consumption of over 3.6kg, while in Europe it is around 2.3kg, so we have a lot to do to catch up."

He explained that over the past few years a cooperative venture between the British and the Irish mushroom growers had been run through an organisation called Bord Bia.

"There have been a number of campaigns "More to mushrooms", "Mushrooms complement everything" and "Just add mushrooms", over the last number of years. The target has been households, predominantly women ranging between 25 and 45 years of age."

"The key issue is that younger consumers aren't eating enough mushrooms, and the research showed that health was the greatest motivation to younger consumers. The approach Australia has adopted is a good one, and quite clearly a similar approach should be working better in Europe."

Mr O'Rourke touched on the role of supermarkets and said their role would certainly change in the future.

He cited the example of the HoMa supermarket in Shanghai. The supermarket is Ali Baba's entry into what the company calls new retail, a store that is the merger of online and off-line shopping, using technology and data to provide what it calls a seamless and more efficient shopping experience for customers.

At HoMa everything is powered by mobile. Using the app, consumers can scan the barcode to find information about a product and receive recommendations for products based on what they have in their shopping basket. One of the biggest attractions is the seafood section, where Chinese consumers can not only handpick their selection but have it cooked to eat on the premises.

"As an industry, we need to be aware of the changing role of supermarkets and be prepared to tap into the different shopping experiences offered," he said.

Mr O'Rourke said one issue that would affect all growers was the potential shortage of fresh water.

"With an increasing number of weather-related problems around the globe, new technologies will come into play. In Israel, highly automated indoor farming is operating at a commercial scale, growing product that is pesticide and chemical free and completely independent of weather and seasonality."

"Importantly the approach is water efficient, saving 95% of the water used compared to conventional systems while lifting the productivity significantly".

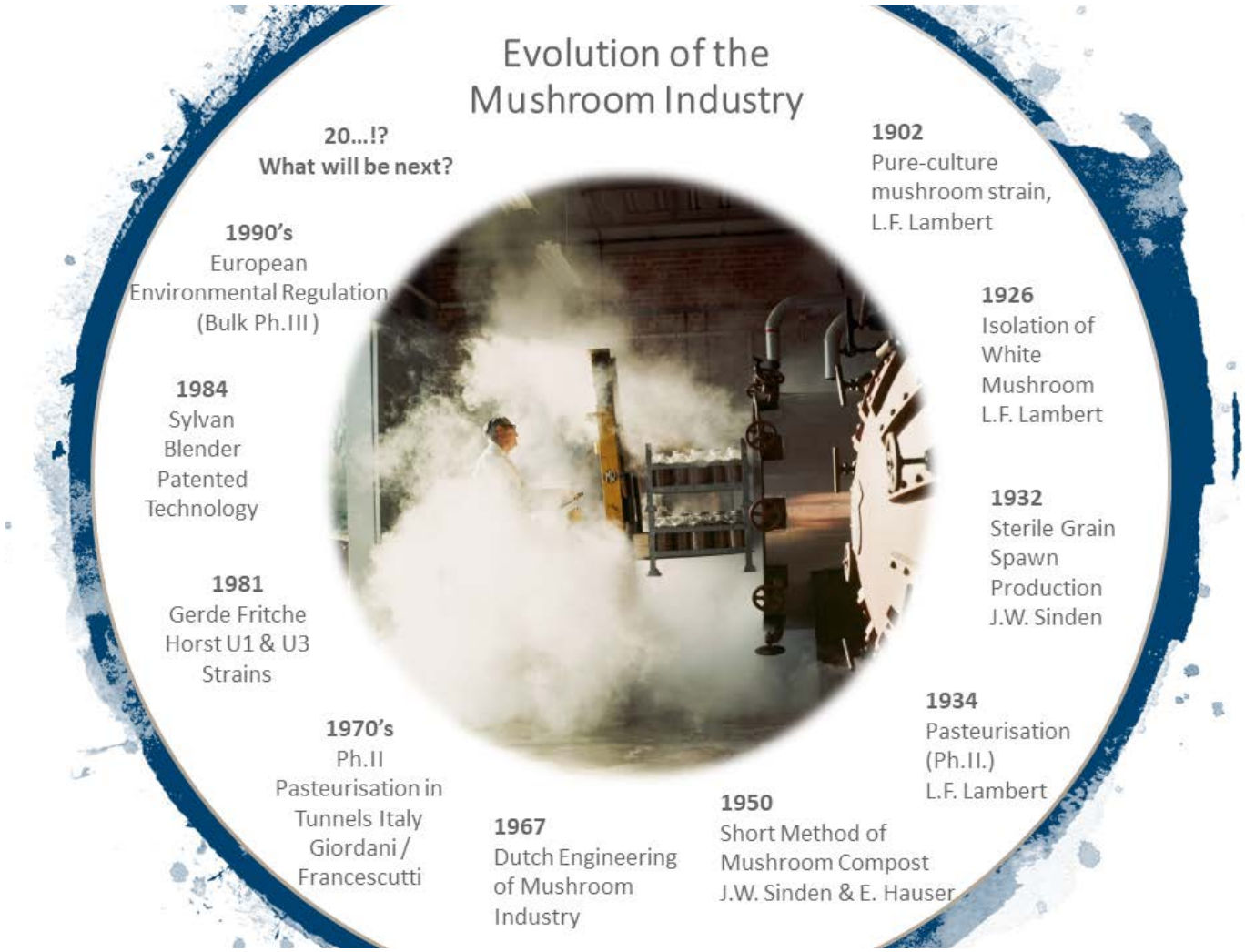
He said the emergence of new technology was inevitable and should be embraced by the industry.

"Automated indoor farming is already happening for other crops, and the question is whether it can be adopted for mushrooms. Different technology may open the door to using less compost or even taking just one flush."

"On the breeding side, CRISPR gene editing may be available to the industry at some time in the future, opening the way for new mushroom strains which improve the utilisation of the growing substrate and further improve sustainability."

Mr O'Rourke said change was inevitable and if you don't like change you will face the prospect of becoming irrelevant.

"The European industry has been fantastic at producing efficiently, and embracing and adapting technology. Despite this, it has not been as successful in the areas of selling and marketing and obtaining the true value for the crop produced," Mr O'Rourke said.



Evolution of the Mushroom Industry

1902 Louis Lambert isolates a pure culture of mycelium. Within a few years, this effectively replaced all imports of spawn into America.

1926 White mushrooms appear on a farm in Kennett Square owned by Mr Denning. Louis Lambert isolates a pure culture (the beginning of the white mushroom industry of today).

1932 Jim Sinden succeeds in sterilising grain and growing spawn on grain (prior to this pure manure was used to make mushroom spawn).

1934 Louis Lambert introduces pasteurisation of Phase 2 compost.

1950 Jim Sinden and Erica Hauser commence a shortened method of making compost.

1967 Dutch decide to re-engineer the mushroom industry and start growing mushrooms on shelves.

1970's Italians Giordani and Francescutti make compost bulk pasteurisation in tunnels. The Dutch took the idea and had been developing the approach since then.

1981 Gerde Fritche bred U1 and U3, the first hybrids in the mushroom industry.

1984 Sylvan introduced blender patented technology and made it a worldwide franchise.

1990's The European environmental regulations started to impact. As a result, phase 2 moved into phase 3. (This technology is still used today).

European Mushroom Production

1988 The French industry is the dominant player in Europe with 195,000 tonnes. The Netherlands, Belgium and Germany between them could only produce 145,000 tonnes, and the UK was producing about 110,000 tons.

1998 French production starts to shrink. The Netherlands, Belgium and Germany starts to increase, and UK production declines. Ireland and Poland show an increase in production.

2008 France has toppled from the position of top producer. The Netherlands, Belgium and Germany continued to expand strongly, and UK production is halved from its position in 1988. Ireland and Poland continue to increase their output.

2018 France is producing just 105,000 tonnes, a decline of 90,000 tonnes over thirty years. The Netherlands, Belgium and Germany are now producing 250,000 tons and Poland, with 310,000 tonnes is now the number one producer in Europe.

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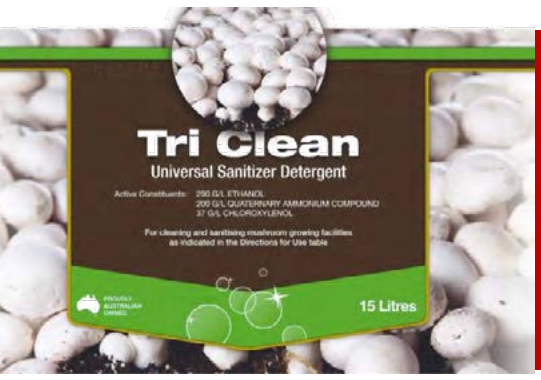

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Using Spent Mushroom Compost as a **Casing Amendment**

One man's waste can be another man's treasure the saying goes. And the saying can be applied to spent mushroom compost (SMS), which in some countries is classed as waste and in others as a valuable resource.

With millions of tons produced worldwide, international mushroom consultant, United Kingdom-based Dr Burden recently addressed the issue at Australian Mushroom Growers Association conference in Sydney covering the topic – SMS as a casing amendment and other alternative uses - the Iranian experience.

Dr Burden explained that for every kilogram of mushrooms produced, the industry produces 5 kg of SMC, opening the door for a range of potential uses.

"Most obvious uses are for an organic fertiliser, soil conditioner or mulch, but it can also be used for pollution control and bioremediation of contaminated soils. It can be burnt as a fuel, even on an industrial scale, and interestingly has major potential for producing insects which is a large up-and-coming market that should not be discounted.

"Back in the 1970s SMC was much sought after in agriculture and horticulture and was used extensively as a soil conditioner / fertiliser. However, the nitrate sensitive zone restrictions now imposed in the UK and Europe is unfairly restricting the use of SMC as it uses total Nitrogen levels, not available Nitrogen. The Nitrogen in SMC is released over time so is not immediately available and rapidly leached as inorganic Nitrogen is.

Dr Burden said the addition of organic materials to the soil should be encouraged as it provides many advantages over inorganic fertilisers.

"SMC also contains a lot of valuable nutrients that plants require, it increases the soil moisture holding capacity and the cationic exchange capacity, so nutrients are held more firmly within it and not readily leached to watercourses, as virtually all inorganic fertilisers are."

"SMC also improves the soil structure, aerating the soil and draining it as well as greatly enhances the biodiversity of the soil by increasing both the macro and microflora."

Above: Compost can provide a viable energy source

Dr Burden outlined that the mushroom industry, in the 1980s and 1990s, spent a lot of work attempting to burn compost. He said the chalk in the casing layer made SMC unviable; however, the ability to split the casing layer from the compost has now changed this situation.

"Improvements in the science and biology of boilers and the pelletization of fuels has opened the door for compost to provide a viable energy source. There are still products on the market in which SMC is mixed with wax, waste oil, coal dust or sawdust and then compressed and extruded into a log and wrapped for convenient use."

Dr Burden explained he had recently worked with SMC as a potting medium for growing seedlings.

"It worked extremely well as the medium has the advantage of the correct physical properties. It can also be easily supplemented with specific nutrients to suit the plant species being grown.

The one problem, he said, was that the fibrous nature of the peat used in Europe prevented the individual briquettes from separating with the now common automated planting procedures being used.

He suggested that the situation could be totally different in Australia, as the surface milled peats commonly used do not have the same high proportion of "rag" found in the deep dug peats used in Europe.

Dr Burden said he had also been involved in the practical side of developing SMC as a casing medium for mushrooms, working with UK growers and a large grower in Iran, Malard Mushrooms. Dr Burden thanked Dr Hossein of Tehran University and Mohammad Mirzadeh now of Scato Plus for their involvement and development of the product.

"Unfortunately, SMC cannot be used

Top: If time and land is available natural weathering can be very effective. Above: Machinery can speed up secondary denaturing

straight from the growing house. It has to be processed first, and while the crop does not have to be cooked out for this operation, it is preferable to do so as the risk of developing cyclic infection increases if the crop and the associated diseases are not killed before emptying the house."

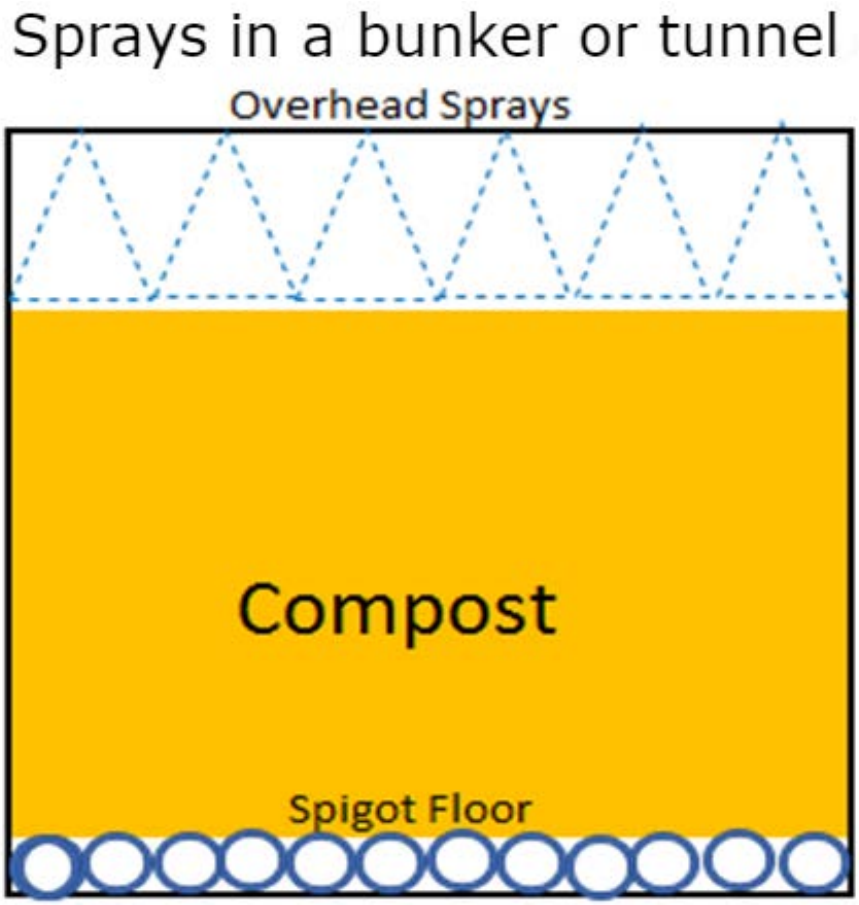
He said it is preferable to perform any SMC preparation away from the growing facilities to lower the risk and reinfection of both materials.

"The processes involved in growing mushrooms on compost, has already gone a long way in breaking down the structure of the straw, but further work is still required before SMC is turned into a homogenous, friable material suitable for the use as a casing soil."

The required process can be broken down into distinct phases: a) breaking down the structure into a friable, homogenous material, b) leaching the salts out of the material, c) allowing it to drain before pasteurising it and d) blending the final product.

Dr Burden outlined two distinct options for this process - a slow natural degradation, or a faster artificial denaturing route.

"The slow route depends on the climate, especially the available rainfall in the area, while the faster forced denaturing route uses a small area of land, and is not dependent on climate, but does require water."



Above: Sprays can distribute water evenly.

He explained that if time and land are available, natural weathering can be very effective, and requires minimal management requirement.

"Windows can be formed and simply allowed to weather. With a rainfall of around 75 cm a year, the operation can be conducted in between one and two years to reduce the salt concentration to usable levels."

"Smaller piles are both more effective and quicker, experience shows that dimensions of around 2 m high and 3 to 4 m wide are ideal. Turning piles periodically prevents colonisation by weeds, and also assists in breaking down the structure of the remaining straws"

Dr Burden said the secondary denaturing could be sped up by using machinery, and a secondary compost process.

"When using windrows and turners, bunkers and tunnels it is better to use fresh SMC as it still contains a relatively high level of nutrients, this process is only reinvigorating the composting organisms to assist in further breaking down the material."

"Temperatures of 60°C can be easily reached within windrows and bunkers, and those high temperatures dramatically speeds up the breakdown process of the SMC. In temperate climates, no supplementary heating should be needed at this stage."

"In the trials, a turner was passed through the windrow every seven to ten days, and it was found there is sufficient energy and food source in the SMC to support a meaningful activity and maintain effective temperatures for up to five weeks.

Dr Burden cautioned that care needs to be exercised when working with the secondary denaturing process to prevent destroying the structure of the material.

"SMC that is too wet will quickly lose its structure and become unmanageable, and if allowed to get too dry, especially in windrows, it will turn to dust in time. As material degrades, the volume reduces and the density increases. Turning piles periodically will assist in breaking down the structure."

"The compost leaving the mushroom house is already at a moisture content of around 60%. The range will be similar for weathering windrows naturally. There is no point in allowing the material to dry too much, excessively dried materials will never regain their original physical structure when re wetted."

"If the material dries out too much, it develops hydrophobic properties and never re-wets or gains the same physical properties as it had originally."

Dr Burden said if the materials weather naturally, little if any additional leaching may be required. He did say however that before using the electro-conductivity (EC) must be checked to ensure that the salt concentration is low enough.

"Peat based casings usually have and EC between 0.5 and 2 mS/cm range. SMC can be over 7 mS/cm but can be lowered with around 3.5 – 4m3 of water per tonne of SMC.

"Passing water through the material will dissolve the salts as it percolates,

removing excess salts in the water that drains from the pile.

"Leaching needs to be done intelligently while preserving as much as possible the physical structure of the SMC. Too much water will ruin the structure and produce a sludge. A steady addition of small quantities of water applied to the top of the pile will leach unwanted salts out very effectively."

He said a similar approach could be used in bunkers and tunnels, where sprays can be fitted to distribute water evenly over the surface.

"Spigot floor units are ideal as they can accommodate all the required phases, providing air to the compost phase, draining the surface liquid away, and drying the material before it is pasteurised."

Dr Burden said the results achieved would depend on the age of the SMC, and the volume of water used.

"Rudimentary trials showed the salts could be reduced with two weeks, and with a more scientific application, altering the pH or using warm water, this process could be further refined."

He explained that before the degraded and leached SMC can be pasteurised, it needs to be drained and dried a little, to allow the steam and the air to pass through it during pasteurisation.

"Draining can be achieved effectively using the floor of a tunnel, or by piling it and turning it occasionally, allowing the excess liquid to flow away."

"Pasteurisation of the composted and leached SMC can be done in a simple tunnel, bringing the temperature up to 60 to 65° C for eight hours before returning it to ambient. No conditioning is required, as the process is all about killing any pathogens acquired during treatment."

Dr Burden said it was very advisable to blend the treated and leached

Top: Sprays can distribute water evenly.
Middle: Before pastuerisation the SMC needs to be drained and dried.
Above: GA comparison of naturally weathered (left) and forced denatured SMC.

pasteurised SMC with a proportion of fresh casing, as 100% SMC casing does not produce an economically viable crop.

"The addition of a proportion of fresh peat provides the necessary microorganisms required for effective pinning as well as improving the physical structure of the material."

He cited work at Malard Mushroom that found a 50% SMC mix, with a 50% European mix or even as high as a 60 - 40% mix, gave an economically viable yield.

"Cheaper blonde peat can be used with SMC, and a blend of 50% SMC, 20% blonde peat and 20% European peat, also achieved good results."

Dr Burden stressed that just like any other casing mix it was important to blend the SMC well to avoid inconsistencies in the mix on the bed. A good blend is essential to obtain a uniform crop, and it also provides the opportunity to adjust the pH or the moisture content if required.

He stated that the SMC casing formulations do not have the same robust structure as deep dug casing mixes as it lacks the fibre that gives the 100% peat casings the remarkable structure the industry cherishes.

"Many alternative materials have been trialled to enhance the fibre content including rockwool, paper mill by-products and coir, and while SMC mixes can have a similar water holding capacity to some lighter peat casings, none have equalled the properties of good deep dug peats.

Above: Its all about the mushrooms – dense and white.

"I'm optimistic that one day we will find something."

Dr Burden said mushroom mycelium would colonise SMC casing in a similar time to conventional casing materials.

"SMC casing can accept and hold sufficient water for high flushes, without undue panning although care has to be exercised when watering the crop. SMC casings can produce yields close to conventional casing soils but the remarkable property of SMC casing is the ability to produce exceptionally high quality, dense white mushrooms with remarkable shelf life characteristics.

Dr Burden believes further potential uses for SMC should be explored, given the very large volumes available in the mushroom industry.

He said using SMC as a casing medium is a potential a lifeline for those locations around the world where obtaining peat is hard, and sometimes economically impossible.

He stressed that if good quality peat is available to the industry as a casing medium, SMC will not challenge its predominance.

Dr Burden concluded. "That the real jewel in the crown for SMC casing is the excellent quality of the mushrooms it produces. The mushrooms are dense, white, with remarkable handling qualities, these are all very important characteristics that improve pick rates and help market the crop,"

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Mushroom production waste streams the focus of attention

A new project has now commenced to examine mushroom production waste streams. The project is being undertaken by Xinova, a global innovation services company that will use its worldwide network to identify technology, processes, products and business models that offer the potential to improve profitability and efficiency in the industry.

In January the project team held a teleconference with the mushroom industry strategic investment advisory panel (SIAP) to help define the areas of most interest and set the project objectives and success criteria.

This step was an important one for the project team as it allowed input from a cross section of industry participants and directed attention towards solving real problems for stakeholders.

Project Leader, Dr Scott Needham, said it is already clear that the some of the traditional waste products of mushroom production such as spent mushroom substrate, mushroom stipes, and water do not have the same impact on all businesses.

"For instance, many smaller farms are generating decent revenue from spent mushroom substrate by selling it onto horticulture product suppliers whereas larger farms that generate significant quantities of SMS may view it as more of a problem and cost to the operation," he said.

The project will run until September 2019. Over the next four months, Xinova will be gathering insights from growers and other stakeholders in the value chain.

It will also survey all currently available processes and technologies world-wide that could offer compelling business opportunities for members of the Australian mushroom industry.

Ultimately the objective of the project is to come back to industry with advice on available approaches to management and value creation from mushroom production waste streams.

Updates on this project will be made available through the Journal and the Industry Update e-newsletter.

Further information:

Project Leader
Dr Scott Needham
Email: sneedham@xinova.com
Mobile: 0439 135 268

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

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Casing soil and correct filling **are a worthwhile investment**

Top: Erik de Groot
Above: A nice structured casing soil with a good even mix of compost added at casing

Most Australian mushroom farms use imported casing soil from Europe. A good, heavy casing soil with a good water holding capacity delivers many benefits, making it worth the investment to import the casing rather than using other alternatives.

However, casing soil must be prepared correctly to get the casing on the growing beds the right way, without losing those benefits. Getting a good, consistent casing on the beds will give better yields and quality. The following process outlines the best way to prepare and adjust the casing soil on Australian farms.

All the big bags transported from Europe have the casing soil inside for up to six weeks. After that, there is extra time being stored in Australia before use, so it's not hard to understand that the wet, heavy casing soil will get some anaerobic spots inside the big bags. Therefore, it is beneficial to open up the bags a few days before use it to get it aerated and get rid of the anaerobic spots. Of course, a good clean space is required for this task.

Another big advantage of this approach is that all bags can be mixed together, which will give much better consistent moisture in the casing. Although the casing companies try to get the same moisture in all big bags it's hard to get that done all the way perfectly through and mixing them all up improves that consistency.

Mixing of the bags can be done with a loader bucket, a Bobcat or something similar. To avoid damaging the structure, it is important not to push too hard when driving into the casing, and to drop it carefully from a minimum height. The process of mixing the casing on a floor also allows the moisture level to be adjusted. Watering can be done on the top of the casing with a hose. After being on the floor for one day, the water will have the time to get through all layers of the casing soil and this will even out the PH level. Uneven PH levels will give uneven grow speeds of the mycelium.

The casing we use in the mushroom industry is influenced by the different climate periods experienced where the peat is harvested. Over the last period, it was very wet and heavy due to a wet winter in Europe. In a wet period, the casing going into the big bags will have higher moisture than the casing loaded in warm and dry summer periods. Those changes occur year round, and they will change the amount of water needed to adjust the casing. It's never a routine job to add water, it needs attention and to be adjusted according to the peat condition.

An alternate method of mixing and adding water is to use a mixing machine. If using this method, it is important not to break the structure of the casing too much or use augers to mix it. Augers will damage the structure by compressing the casing and press out all air between the clumps.

Above: Not the ideal situation but if there is no clean space available you can unload the casing soil from the big bags directly into the machinery.

The casing equipment cannot handle very heavy casing if it has an auger instead of a spinner, as the auger will damage the structure of the casing soil, and it's impossible to get that structure back after the casing has been through the auger. Getting casing equipment with spinners instead of an auger is very beneficial as spinners will break the casing just enough and keep the right structure.

At filling, don't run the compost added at casing spinner on the head filling machine too fast as that will break the casing more. Instead, be careful to put the spinner high enough to get the right amount of compost added at casing. Too much compost added at casing in the casing can reduce the water holding capacity of the casing. More mycelium will grow into the casing layer, and if there is mycelium, there can be no water.

What you also have to manage on the filling machine is how much casing is behind the levelling spinner. When there is too much casing behind the spinner, the casing gets thrown back over it. The casing layer will then get lumps on top and is very uneven before it gets pressed by the final roller. The final roller's main function should be to correct and press back some loose pieces of casing staying on top but in this scenario, it's levelling out the top of the casing layer and pressing back all the lumps on top.

Those lumps get anaerobic, no mycelium will grow into that, also not from the compost added at casing, and there the mushrooms will start to pin just under the surface while lifting the casing on top. Mushrooms will be dirty and over pinning can occur easily on those spots. A certain amount of casing is required before the spinner to prevent the creation of holes in the casing layer; however care should be taken so it is not too much that it throws it over.

Another solution for that problem is to put an extra spinner on the head filling machine so the second spinner can do extra levelling before the casing reaches the final roller.

Filling grow rooms correctly prevents later problems that cannot be corrected. A lot of attention is needed, and good filling equipment is essential to get great results. The imported casing provides extra benefits, but it must be used correctly to deliver the best growing condition.

As the situation for each farm is different, don't hesitate to ask for technical support from suppliers.

Erik de Groot
Glags.spain@gmail.com

your blend for life

With our product Topterra mushroom casing we deliver as Legro world's best casing for professional mushroom culture.

Legro mushroom casing solutions is a specialist in the production of casing for professional mushroom culture within the Legro Group, a family business with the fourth generation currently standing at the helm, which delivers substrates and growing media in more than 40 countries world-wide.

For more information about us, please visit www.legro.nl or contact one of our account managers.

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UPDATE

A[xxxx]

GROWERS COMMUNICATION STRATEGY:

How to proceed in a crisis

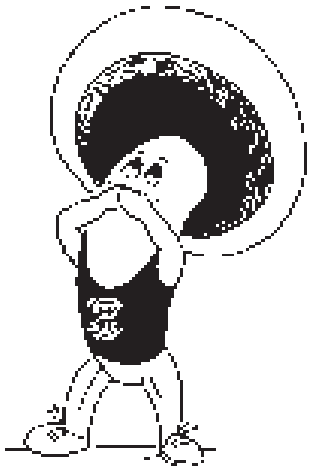
AMSAFE safeguarding our future!

1

Phone 02 4577 6877

- If you suspect a possible crisis
- If you are experiencing difficulties that may become a wider crisis
- If you aren't coping with a crisis

2



Say nothing

- Refer all enquiries to AMSafe
- Refer the media to AMSafe

3

Follow the leader

- Wait for AMSafe to issue you with the 'one message'

AMSAFE – protecting the assets and wellbeing of the Australian Mushroom Industry!

Australian Mushrooms Journal - Edition 1, 2019

This Journal has been produced as part of Project MU 15001:
Communication program for the Australian Mushroom Industry 2016-2019.

The project has been funded by Horticulture Innovation Australia using the mushroom industry levy and funds from the Australian government.

Horticulture Innovation Australia

A.M.G.A.