

Australian  
**MUSHROOMS**  
**JOURNAL**

EDITION 4 - 2019



**Hort  
Innovation**  
Strategic levy investment

**MUSHROOM  
FUND**



# Australian MUSHROOMS JOURNAL

EDITION 4 - 2019

## Contents

- 1** EDITORIAL
- 2** AMGA CHAIRMAN'S REPORT
- 3** AMGA GM REPORT
- 5** PLENTY OF MUSHROOM ACTION OVER SUMMER
- 7** NEW MUSHROOM MARKETING MANAGER APPOINTED
- 8** YOUNGER AUDIENCES KEY TO INCREASED CONSUMPTION
- 10** AUSTRALIAN MUSHROOMS CAMPAIGN TRACKING
- 14** KNOWING THE HEALTH BENEFITS OF MUSHROOMS
- 19** GROWING THE FUTURE, TOGETHER
- 22** WHEN WATER RELATIONS GO BAD: NAVIGATING UNCHARTED WATERS
- 29** WHEN PUSH COMES TO SHOVE: REDUCE SUSCEPTIBILITY TO BRUISING
- 33** AMGA MASTERCLASS DELIVERS A LEARNING EXPERIENCE
- 38** THE SEVEN PILLARS OF COMPOSTING WISDOM
- 42** GROWING CONSISTENCY: IS IT "SINE" LANGUAGE?
- 44** THE IMPORTANCE OF UNDERSTANDING AMSAFE
- 48** RECYCLED ORGANICS AS AN ALTERNATIVE CASING MATERIAL
- 52** FOOD SAFETY AND QUALITY CERTIFICATION UPDATE
- 54** FOOD DEFENCE - ARE WE PREPARED?
- 56** HORT INNOVATION UPDATE
- 58** ON-FARM SAFETY - COMBATting COMPLACENCY
- 60** HAZARDOUS SUBSTANCES & NATURAL EMERGENCIES



The Australian Mushrooms Journal is produced as part of the Mushroom Industry Communication program [MU18001]. This project 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 | Editorial: Chris Rowley, Editor - 04 1514 0253 | Judy Allan, Editorial Consultant - (02) 6767 1057 | Publication Dates: March / June / September / December | Copy Deadline: Six weeks prior to the cover date | Subscriptions: The Journal is available to levy payers and others involved in the Australian Industry. The Journal is distributed in electronic and print formats. 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 [chris.rowley@optusnet.com.au] | Editorial Policy: The opinions expressed by contributors and advertisers are their own and do not necessarily represent the views of Hort Innovation. No responsibility will be accepted for any statements made or views expressed in this journal, or for any advertisements included. Hort Innovation reserves the right to edit, rewrite, withhold or reject any or all material whether it be editorial, advertising copy or advertorial. If editorial changes are made, the Editor will contact the author before publication for approval. Manuscripts, correspondence, change of address requests should be sent to the Editor for consideration. All material is copyright to Hort Innovation. Articles in their entirety may not be reproduced in any other publications without written permission of Hort Innovation.

AMGA Contact | Phone: (02) 4577 6877 / Mail: P.O. Box 576 Crows Nest NSW 1585

# EDITORIAL

Well, that is the end of 2019 and what a year it has been. Plenty of projects and activity to report so I would encourage you to take the time to have a thorough read of this Journal during the Christmas/New Year period.

This edition marks a changing of the guard for mushrooms with two new appointees made by Hort Innovation. In the marketing area, we welcome Olivia Grey, who steps up as Samantha Ferguson takes maternity leave.

And in the other change Mark Spees has been announced as the new Mushroom Industry Strategic Partner [previously known as Relationship Manager]. You can read about both these new appointments [Olivia in the Marketing section and Mark in the Hort Roundup section]. A big welcome to both and we as an industry look forward to working with you.

In our marketing section this month we cover off the results for the past six months and look at some of the activities being conducted over the summer period. To round it out we also have included a detailed article on the recently completed consumer research - material of great interest to anyone who wants to know the most recent learnings when it comes to consumer behaviour.

This edition has several on-farm stories – with some drawn from the recent AMGA Masterclass, and others from the Pest and Disease project.

From the Masterclass events, the articles cover composting, the importance of consistency in growing quality mushrooms, and the operations of AMSAFE. There is also



pictorial coverage of each of the State events, so if you didn't attend, you could see what you missed [and pencil in the diary not to miss the next series].

The Pest and Disease project covers off the impact of water stress and the impact of bruising in a couple of valuable articles that are mandatory reading for anyone wanting to maintain quality.

You will also see in the AMGA section that 2020 is a conference year, so mark your diaries and clear the time to attend. There will be further updates in future editions of this publication, so keep an eye out for details on the speakers and the topics to be addressed.

If you have any feedback on the articles or would like to make some suggestions for future editions, please let me know.

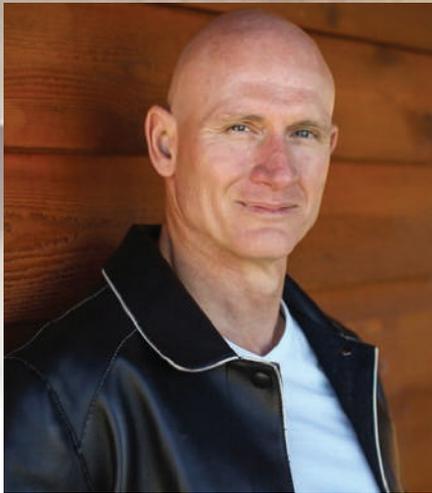
I look forward to catching up again in 2020 – happy mushrooming everyone.

Chris

This project has been funded by Hort Innovation, using the mushroom research and development levy and contributions from the Australian Government.

**Hort  
Innovation**





*Kevin Tolson, Chairman,  
Australian Mushroom Growers Association*

Dear AMGA Members,

I wish to thank you for your trust in electing me among the new set of directors for this year. As in my previous terms, I will work diligently for the success of our industry.

I also would like to express my appreciation to our outgoing Chairman, Tim Adlington, for his efforts and guidance of the board and the industry over the last two years in the midst of various challenges faced by our industry and the Board.

Among the challenges that continue to affect the industry is the impact of drought conditions, especially north of the Murray River [the border between New South Wales and Victoria]. Currently, straw is still not as plentiful as we expect it to be in a normal season.

However, there are plenty of supplies the more south you go. The outlook on pricing is expected to be better compared to last year, where there was far less straw available and less hay available to competing agricultural industries.

As we all know in the industry, the plan to double the size of the Monarto facilities by Australia's largest producer and our fellow grower Costa has meant significant volumes will become available in the market now and in the future. Some of this increase is being negated by the recent closure of their Tasmanian and Queensland farms, all of which are older farms and I would believe are far less efficient than a modern farm.

Aside from Costa, there has also been expansion of other farms within the in-

# AMGA

# CHAIRMAN'S REPORT

dustry, notably in South Australia such as P&L Rogers and SA Mushrooms. I believe growing facilities are performing very well around the country which means there is far greater stock compared to 12 months or so ago. Figures of 10-15% have been reported to me by both growers and marketers of mushrooms in the industry.

With consumption having not increased over the same period, we obviously would have an oversupply of mushrooms and enhanced supply exceeding demand. I'm reminded of a time in the industry when we did no promotions whatsoever in 2003-2005 leading to supply outstretching demand for our product and pricing plummeting downwards.

All of these current concerns are understood by the AMGA Board and the Mushroom Strategic Industry Advisory Panel [SIAP]. Much discussion, debate, and effort can be expected between the Board and SIAP to get the best results possible from our industry levy.

As part of the Board's efforts, a Strategic Planning Workshop was done in August to set our path for the next two years. **The AMGA Board's mission is to drive value for Australia mushroom growers and it's the vision of the Board to make mushrooms a vital and unique part of the Australian diet.**

You will find the details of the strategies that support this mission and vision in our Relationship and General Manager Martine Poulaine's message on Page 3. You may have met Martine Poulaine as part of the AMGA Masterclass held in various states recently, or through the visits conducted with Geoff Martin since early this financial year.

Should you have any questions about our Strategic Plan, please contact Martine,

myself or any of the members of the Board at any time.

As far as new projects are concerned, there are two Research and Development projects coming up to the SIAP which will be put in by the AMGA:

- The first project is in relation to the elasticity of demand for mushrooms at different retail pricing levels.
- The second project would ascertain the value of our levy amount in comparison to the past [taking into consideration inflation, advancements in spawn quality, Phase 3 technologies for spawn run, as well as any changes in media costs]. I estimate that we pay approximately 5-6 cents per kg of mushrooms produced.

It's worth noting that compared to 10 years ago, it is more difficult to reach consumers, and this adds up to additional marketing and promotion [M&P] costs for us now. I believe that key to our success in M&P is a confident relationship with the Mushroom SIAP in order to get the best M&P program possible and increase per capita demand.

With the ongoing pressure on pricing around the country and increasing supply, it is imperative that all members are working to reduce costs and maintain efficiency. Diligent efforts made on farms to increase quality and reduce costs I'm sure will be rewarded with a better bottom line.

Best regards

*Kevin Tolson*

# AMGA GM REPORT



*Martine Poulain, Relationship & General Manager, Australian Mushroom Growers Association*

## STRATEGIC PLAN

With the 2017-2019 Strategic Plan and directives achieved, the AMGA board met in August for a planning day and to establish the strategic direction of the association for the next two years.

Our four key objectives were defined as follows, and our next board meeting will determine how the AMGA will operationally proceed to ensure we touch on all four pillars as listed below:

### 1. AUSTRALIAN MUSHROOMS BRAND

- Collaborate with Hort Innovation on the most effective marketing and promotion for Australian mushrooms.
- Identify risk and manage reputation on growers' behalf.

### 2. COMMUNICATION / INFORMATION TRANSFER

- Understand what information is of the highest value to growers and how it is best received.
- Gather industry insights and knowledge, and transfer to members and stakeholders.

### 3. RESEARCH, DEVELOPMENT & EXTENSION OVERSIGHT

- Ensure Hort Innovation applies member levies for the most effective R&D outcomes.
- Socialise R&D project outcomes with industry participants in practical, commercial ways.

As we hurtle towards the Christmas period at lightning speed, I find myself reflecting on my first few months in the Relationship and General Manager's chair. With this, my first column in our industry publication, which also happens to be our last Journal for 2019, I'd like to bring you along with me in spirit, so you can get a first-hand look at what we have achieved over the second half of 2019, and what we hope to achieve for you, our members, as we head towards 2020.

## MEMBER MEET AND GREETINGS

I'm sure you will all be familiar with Dr Geoff Martin, who was interim GM until I commenced in the role. He was gracious enough to get behind the wheel of his ute for six weeks in August/September, and introduce me to our members around the country. With "communication" to YOU our priority, it was vitally important to meet you all, and have conversations face to face.

- How do we know what's concerning you if we don't ask?
- Are we hearing what your industry issues and concerns are?
- Are we servicing you properly and open to your feedback and suggestions?

Please know that I have an open-door policy, and can be reached at any time for a casual chat or robust discussion. Our board meets regularly, and we are here to ensure our decision making is industry representative.

## COMPOSTING MASTERCLASS WORKSHOPS: A RESOUNDING SUCCESS

In October, industry stalwarts, Judy Allan, Mike Hill, and Dr Geoff Martin delivered an intensive workshop over four States to just under 80 AMGA members.

Each course included a farm tour on the second day, and I'd like to extend a special thank you to our farm tour hosts – Parwan Valley Mushrooms in VIC,

Premier Mushrooms in NSW, Revitalise Enterprises in SA, and SJW Mushrooms in QLD. The overwhelming feedback from our attendees was positive about:

- The opportunity to network with fellow growers and composters;
- The opportunity to have industry experts deliver the information; and
- The tips and techniques gained which they could proactively take back to their own farms.

It's so important for industry associations like AMGA to provide Professional Development opportunities for their members, so we are hoping to run more of these types of workshops in the near future.

## 2020 CONFERENCE, ADELAIDE: WED 14 OCTOBER - SAT 17 OCTOBER

The conference committee met in November to discuss the 2020 conference, and key speakers and sponsors are already being contacted. If you have an interest in being involved, please get in touch and save the date!

## HORT INNOVATION

Regular meetings with key staff at Hort Innovation continue to take place every month, and we are planning a road-show-style of event in the first half of next year to bring Hort Innovation to you, our members, so you can hear what they are doing with marketing and R&D. So please look out for an update in the Journal and e-newsletters.

## AMSAFE AND TESTING

A reminder that the AMGA has a crisis management plan called AMSAFE to help it respond to a variety of situations that may arise, from biosecurity issues to market crisis and more. If you have any concerns, please call (02) 4577 6877. This is also a good time to remind our members that the AMGA provide testing kits to our members and if you need one, please contact [admin@amga.asn.au](mailto:admin@amga.asn.au).

#### 4. MEMBER SERVICES & SUPPORT

- Frequent, effective member interaction and engagement that informs the work of the AMGA.
- Enhance grower accreditation and compliance: food safety, workplace, employment and other requirements.

#### CHRISTMAS CLOSURE

The AMGA office will close for the Christmas break from Monday 23 December and reopen on Monday, January 6. The phone will be manned in case of any AMSAFE emergency, so please call the AMSAFE number should you require any assistance.

*Martine Poulain*

## EXPRESSIONS OF INTEREST: Marsh Lawson Steering Committee

Hort Innovation is seeking expressions of interest (EOI) from suitably qualified and experienced individuals to the Marsh Lawson Mushroom Research Centre Steering Committee.

The role of the committee will provide direction for the Marsh Lawson Mushroom Research Centre and in the selection of new research projects in consultation with the mushroom industry SIAP, AMGA and Hort Innovation.

All relevant stakeholders from the mushroom industry, including levy payers are encouraged to apply.

For further information please contact:

**Martine Poulain**  
Relationship and General Manager  
Australian Mushroom Growers Association  
[martine.poulain@amga.asn.au](mailto:martine.poulain@amga.asn.au)

## AMGA Board of Directors

The following people were elected at the recent AMGA Annual General meeting to form the Board of Directors of the Australian Mushroom Growers Association.

**Mr Kevin Tolson**  
Chairman  
Regal Mushrooms

**Mr Michael (Mick) Surridge**  
Deputy Chairman  
Scatoplus

**Mr Geoff Martin**  
Treasurer

**Mr Tim Adlington**  
Executive Director

**Mr Carmine Calisto**  
Director  
Global Axis Import Solutions

**Mr Jose Cambon**  
Director  
Costa Mushrooms

**Mr Phil Rogers**  
Director  
P & L Rogers Mushrooms

**Mr Robert Tolson**  
Director  
Premier Mushrooms

### AMGA Staff

**Martine Poulain**  
Relationship & General Manager  
Email: [martine.poulain.amga.asn.au](mailto:martine.poulain.amga.asn.au)

### AMGA Mailing Address

**Australian Mushroom Growers' Association Ltd**  
PO Box 576, Crows Nest NSW 1585  
Phone: (02) 4577 6877

# PLENTY OF MUSHROOM ACTION OVER SUMMER

While consumers look forward to so time off over Christmas and the New Year, Australian Mushroom promotions remain hard at work, encouraging consumers to pick up a few more mushrooms and add them into their everyday meals. In addition to the “always on” public relations and social media components, the campaign over this period will also include an in-store sampling program. Details on these activities are included below.

## IN STORE SAMPLING

Shoppers across Australia are being shown how easy it is to make everyday dishes much tastier with mushrooms, with in-store sampling now underway.

The first phase of the Summer In-store Sampling program will run nationally from 14 November through until 14 December in selected Woolworths and Independent stores. The second phase will commence on 3 February and run through until 5 April. This phase of activity will be conducted in Woolworths, Coles and Independent stores.

## PUBLIC RELATIONS

Media relations activities continued to deliver excellent exposure for Australian Mushrooms, with tips, recipes and content from Ambassador Miguel Maestre reaching Australian consumers.

Recent highlights include two pieces in Woman’s Day (September and December issues), five recipes on Australia’s Best Recipes and the cover of Buy Australian magazine.

During the period from August to October, these activities delivered 11.5 million opportunities to see Australian Mushroom messages.

During December a range of summer activities was undertaken including

a Christmas themed direct mail to a database of over 40,000 subscribers, and the delivery of hampers to 15 top tier media and influencers. It is anticipated that the hamper delivery will drive further coverage for mushrooms over the coming months.



*Click here to GET THE RECIPE*

*Miguel's*  
**ONE ROLL WONDERS**  
You can prep these mushroom and cheese croissants in advance and pop them in the oven just as your guests arrive - perfect for Christmas entertaining! Prep time: 5 mins Cook time: 15 mins



*Christmas hampers were delivered to 15 top tier media and influencers*

*Plenty of great recipe ideas were delivered in the Christmas direct mail to 40,000 subscribers*

## SOCIAL MEDIA

When it comes to social media and Australian Mushrooms, strategic work is undertaken to provide fans, or followers, with relevant information that they can use and share with others.

Australian Mushrooms Facebook and Instagram pages connect directly with mushroom lovers, providing regular inspiration on how mushrooms can make everyday meals much easier and much healthier.

All the posts through these channels are supported by optimised advertising to ensure the widest possible cross-section of the target market sees the content.

Popular Facebook posts can reach tens of thousands of people in an engaging manner.

The post shown [right] was posted in October and highlights the potential impact of the approach, with thousands of likes and hundreds of comments and shares.

It is this ability to share, where users can 'repost' the information, that provides a substantial opportunity to leverage the Australian Mushrooms message as widely as possible.

Instagram also provides the ability to engage with a cross-section of people interested in good food.

While the Instagram page is used to drive engagement with Australian Mushrooms recipes, the post highlighted [below right] is an example where recipes from other sources can be used and shared to encourage people to eat more mushrooms. Almost 11,000 people liked this post.

In a strategic sense, social media is used to support key advertising messages in ways that engage with this audience.

The figures provided on this page provide a snapshot from August to October 2019.



### Facebook

- ❖ **IMPRESSIONS:** 4.2 million [the number of times a post is displayed]
- ❖ **ENGAGEMENTS:** 133.8k [likes, comments, shares, link clicks and photo views]



### Instagram

- ❖ **IMPRESSIONS:** 1.6 million
- ❖ **ENGAGEMENTS:** 153k [likes, comments, shares, link clicks and video views]

## BBQ PROMOTION

In the lead up to Christmas this year Australian Mushrooms joined with BBQ maker Weber to promote the use of mushrooms over summer, with a competition ending in mid-December 2019.

With the BBQ season in full swing, it made good sense to encourage consumers to add a few more mushrooms to their next BBQ meal.

The premise behind the competition was simple. To enter people just needed to share their best BBQ Australian Mushroom dish on their public Instagram channel or the Australian Mushroom Facebook page, using a specific set of tags [@australianmushrooms / @weberbbqausnz / #BBQMUSHIES].

The winning entry received a Weber Q2200 Premium BBQ valued at \$479.

For Australian Mushrooms the competition generated conversations and engagement, with a range of new posts and images on social media, highlighting ways to BBQ mushrooms.

Encouraging people to get involved is an excellent way of leveraging the mushroom message, and simple competitions like this are one avenue of fostering this involvement.



# NEW MUSHROOM MARKETING MANAGER APPOINTED



Hort Innovation has announced Olivia Grey as the new Marketing Manager for Mushrooms, replacing Samantha Ferguson who has been managing the Australian Mushroom Marketing program since February 2018. Samantha is on maternity leave from Monday 9 December.

Olivia has been working at Hort Innovation since November 2017 as the Marketing Manager for Apples & Pears, and in her time at Hort has also worked across the Raspberry & Blackberry and Turf industries. In 2019, she was recognised as the PMA-Produce Plus Marketer of the Year for her Hailstorm Heroes marketing campaign.

Prior to Hort Innovation, Olivia brings experience in marketing, sales and trade marketing from her previous role at Reckitt Benckiser, managing top tier brands such as Veet and Scholl. She is looking forward to getting to know the Mushroom industry and working on the program.

Contact: Olivia Grey – 0419 207 151 | [Olivia.Grey@horticulture.com.au](mailto:Olivia.Grey@horticulture.com.au)

# YOUNGER AUDIENCES KEY TO INCREASED CONSUMPTION

*As reported in previous editions of the Journal, the marketing program for Australian Mushrooms has incorporated a multi-layered campaign, with messaging delivered through television, radio, out-of-home locations, digital media, public relations and social media. The following is a report presented to the Strategic Investment Advisory Panel, outlining the results for the period June to December 2019.*

## STRATEGY

The Australian Mushrooms approach for July-December 2019 focused on two younger audiences, identified as the most significant opportunities to increase mushroom consumption – Young Families and SINKs/DINKs (SINKs – single income no kids / DINKs – double income no kids).

To identify the potential opportunities, the media habits of the two groups were carefully considered, including differences in metropolitan and regional channel consumption. This approach then allowed the development of a plan impacting on both groups at crucial moments of meal planning.

## OBJECTIVES

Key objectives in this planned burst of activities were awareness of the ease, taste and health messages, and to impact the path to purchase, both for pre-planners and more spontaneous shoppers.

## CHANNEL PERFORMANCE

The channels included in the campaign were regional television, outdoor, audio, and digital. The highlights of each channel's performance to date are outlined in this article.

- Television

In regards to television, Australian Mushrooms were present in key regional markets around Australia. This approach helped to maximise the cost efficiency of regional media and reach a significant number of Australian who reside in non-metropolitan areas. Over the course of the campaign Australian Mushrooms appeared across Channels 7, 9 and 10.

The goal was to reach at least 40% of the target audience two times or more with the mushroom message in each market, and in all markets this goal was exceeded. This outcome was helped by the negotiation of bonus spots across all markets.

During the campaign, Australian Mushrooms appeared in key 'big event' programs including The Block, The Masked Singer, The Bachelor, Survivor, and coverage of The Ashes Cricket Series. This schedule was boosted with General Entertainment and News programming such as The Chase, Better Homes & Gardens, Home and Away and the Evening News.

- Outdoor

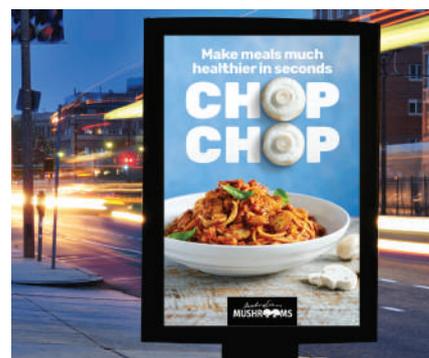
Outdoor media is an effective way to drive mass awareness and capture attention, with 79 per cent of grocery buyer's claiming to have seen outdoor ads in the last week (Roy Morgan, Dec 17).

The outdoor activity conducted during this period consisted of a mixture of retail, street furniture and bus panels. The use of retail panels in close proximity to stores was used to serve as a final reminder for shoppers heading in store.

These street furniture and transit formats were designed to impact consumers on their way home during the evening commute, which is considered a key time for meal and shopping decision making.

Retail activity ran nationally with 100% proximity to key grocery stores commencing on 1 September and concluding on 9 November. Landscape panels with mushroom advertising reached almost 4.4 million consumers, while portrait panels reached almost 3.7 million.

Street furniture ran on the Eastern Seaboard, and bus panels were used in both Adelaide and Perth.





This component commenced on 2 September and concluded on 28 October and reached almost 4 million consumers.

- Digital

The digital campaign incorporated several channels including Catch Up TV, Youtube and display ads, and has overdelivered on planned impressions, with the campaign delivering almost 6 million online views of mushroom advertising, above the target of 4.7 million.

Catch up TV performed well with placements across all major networks including SevenPlus, NineNow, and TenPlay. This format achieved high completion rates [where a video plays through until the end] with current results tracking at 95% vs a benchmark of 70%, and delivered over 900,00 online views. Key shows like The Bachelor and The Block during the campaign drove high viewing and provided cost-efficient placement across the networks' platforms.

The use of the shorter 'bumper' video format on Youtube, has continued to perform well with completion rates currently tracking at 91% vs the benchmark of 70% and delivering over 3.7 million online views of the mushroom creatives.

The campaign has continued to use FlyBuys data to target display ads and this approach has continued to deliver good results, with the over-delivery of planned impressions [an impression is counted as every time a video is shown to someone]. The activity concluded on 30 November and a report on the performance in the key buying segments is currently being prepared.

- Audio

Forty per cent of grocery buyers consider radio an important part of their daily routine; 63 per cent listen to radio on the way to the shops, and the majority [78 per cent] of listening is in the car [Roy Morgan June 18].

Australian Mushrooms radio activity ran from 1 September to 16 November across a mixture of the KIIS, Gold, Smooth and Nova networks in metropolitan radio and key networks in top regional markets. A mixture of 15 and 30 second spots were used featuring the new, previously tested, creative.

The audio activity was extended through digital channels with the inclusion of podcasts and Spotify, commencing on 1 September and concluding on 14th November.

Within Spotify, Australian Mushrooms was presented through a mix of both audio and video within the platform. The Mushrooms audio and video ad was played over 750,000 times

on the platform, with mushrooms only playing for completed listens of the ad.

The majority of impressions came through mobile devices with completion rates peaking between the hours of 4pm and 6pm, when listeners were likely commuting home. The podcast activity also delivered good reach for the campaign, providing a cost-efficient extension of the audio spots.

Our campaign also included a partnership with The Squiz, a free weekday email and podcast, that provides people with a quick and easy way to keep up with the news.

The partnership included host reads embedded within the podcast as well as content in the daily electronic direct mail format.

This approach allowed Australian Mushroom to place various messages and recipes across the platform during September, October, and November.

There were almost 100,000 podcast listens where mushrooms were featured, and the emails drove high click through rates with the Mushroom Risotto recipe included in the 3 October podcast driving 1,8350 clicks to the Mushrooms website.





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](http://horticulture.com.au)

# AUSTRALIAN MUSHROOMS CAMPAIGN TRACKING

## 1. THE STORY SO FAR

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

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

Since the campaign has launched, we have found areas to optimise and enhance the creative strategy and media mix. In the last research, we identified two important issues and challenges to be addressed.

- Strong recall for spend but needed to reach more people: Previous research indicated that

we have relatively high campaign recall for the amount invested but we need to reach more people in order to significantly increase volume further, particularly during off-peak periods.

- Message hierarchy needs to be 'flipped': Key message take outs were heavily skewed towards health rather than taste and ease. Our opportunity research conducted in 2015 highlighted the need to focus on taste and ease to reach our target opportunity groups given that health, while extremely important, does not differentiate mushrooms from other categories.

The latest campaign since revised both the media strategy (greater focus on digital channels and radio) as well as revising messages in all campaign executions to drive the taste and ease themes. Our research among general consumers helps

evaluate the campaign and provide further direction on how it can continue to be improved to impact sales and consumption frequency.

## 2. HOW WE EVALUATE THE MUSHROOM COMMUNICATION STRATEGY

**A quantitative approach to evaluating and optimising the strategy**

15-minute online survey of home cooks – covering both our primary and secondary targets. This stage asked consumers if they had seen the campaign, [and if so] where they had seen it, and the key message they got out of the campaign. Regardless of whether they had seen the campaign or not, we presented the campaign and asked a range of questions to better understand what might drive consumption.

## Key messages of taste and ease are being clearly delivered across the campaign

Unprompted Message Take Out: Total campaign



Taste	38%
Ease	33%
Health	18%

- “Mushrooms are versatile, **tasty** and **easy** to incorporate in meals”
- “Mushroom are **easy** to cook and easy to prepare. They also makes your meal **tastier**.”
- “Its **easy** to add mushrooms to a variety of meals to make them **tastier**”
- “**Easy** and **nutritious** - good for the whole family”

MESSAGES REGARDING THE HEALTH BENEFITS MUSHROOMS PROVIDE ARE ALSO PULLING THROUGH, BUT TO A LESSER EXTENT

### 3. WHAT WE FOUND: THE MUSHROOM LANDSCAPE

- Campaign Recall**

Prompted awareness of the campaign this wave [wave 8 - Nov 19] was 17%. Awareness is slightly [but not significantly] lower than the previous wave [compared to 21% in wave 7 in April 2019] however it is a similar level to awareness levels in wave 6 [19% in September 2018] indicating time of year could influence awareness levels, potentially because of increased advertising clutter during the end of year period.

However, our framework that looks at drive, i.e. conversion from awareness to other key performance indicators shows that we are ahead of benchmarks/norms in terms of comprehension and motivating purchase. This suggests that the creative underpinning the campaign is effective, however there is room to improve reach of the campaign.

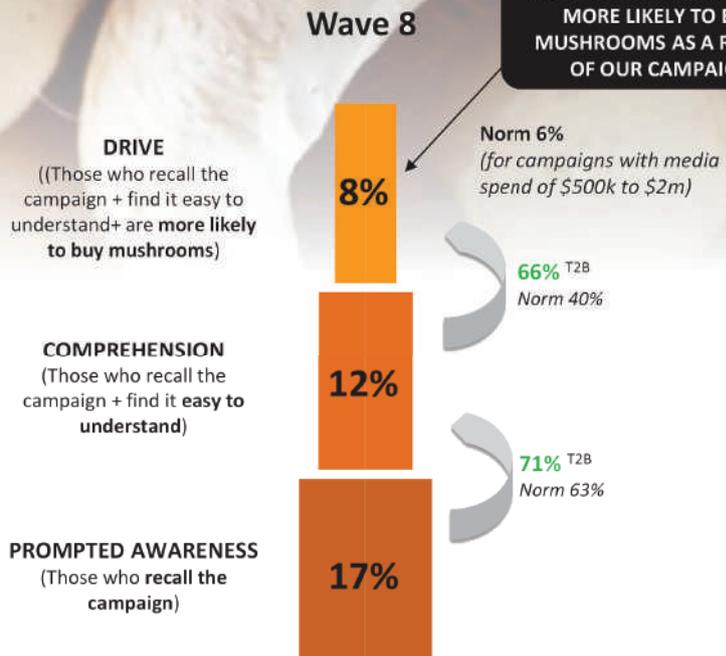
- Campaign Messaging**

We asked those who recalled seeing the campaign what they thought the main message was. We found that this wave of tracking showed that taste and ease were the most common main message outcomes. This coincides with an indicative increase in the proportion of respondents who claim the campaign is effective at driving purchase intent [vs. the last wave of tracking]. Messaging is particularly effective in television advertising however all channels perform above tracking norms in terms of message comprehension.

- Impacting Attitudes to Mushrooms**

We have maintained key brand associations during this campaign. In total 87% of cooks stated mushrooms were quick and easy to prepare, with 85% highlighting that they are delicious and help add richness/depth of flavor to a meal. From a messaging point of view, there is potential to further drive the message around ease, as well as reinforcing the 'taste/flavour' within the vegetable category.

Category momentum and purchase frequency is continuously improving which creates a big opportunity



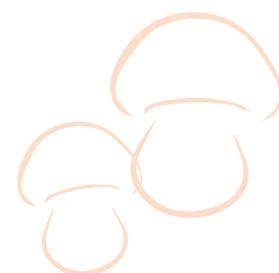
to promote new ways to include mushrooms into existing meals or alternatively as a meat substitute. Mushroom purchase frequency has returned to early 2018 levels, with consumers purchasing mushrooms four times a month on average [vs 3.6 times a month in April 2019]. For those consumers that state they are purchasing mushrooms more often than they used to, the top reason is that they have cooked new recipes that have included mushrooms. As such, recipe inspiration through channels such as social media remain key to driving consumption.

#### 4. WHAT DOES THIS ULTIMATELY MEAN?

- Increasing awareness and optimising media mix** – Evidence shows the campaign message is compelling and motivating. Television was an effective channel when it came to driving behaviour as it is a powerful media for delivering the message of taste and ease. However, there is still a role to play for digital, out-of-home [OOH], and radio as they are effective at continuing this message [driving frequency] and prompting behaviour, especially near point of sale [OOH]. It is

important that we continue to optimise the media channel mix to ensure we achieve of balance of message effectiveness, reach, as well as ensuring that audience see the campaign often.

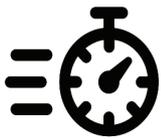
- Need to maintain the message hierarchy** – Taste is one of the key drivers for including mushrooms in meals. The current messaging is helping mushrooms move towards owning this attribute in the vegetable category. Ease is the other key driver – which can be both a push and pull factor of mushroom use. By focusing on the ease and speed of preparation, we need to continue to drive home how simple it is to include mushrooms in home cooked meals as part of the main messaging.



# Mushrooms continue to be held in high regard, with the majority agreeing they are quick/ easy to prepare, delicious, different and versatile

## Attitudes to mushrooms – Top Performing

Mushrooms are quick and easy to prepare



87%

Mushrooms add a unique flavor to every meal



85%

Mushrooms are delicious



85%

Mushrooms are different to other vegetables



83%

Mushrooms are versatile



82%

Mushrooms make any meal much healthier

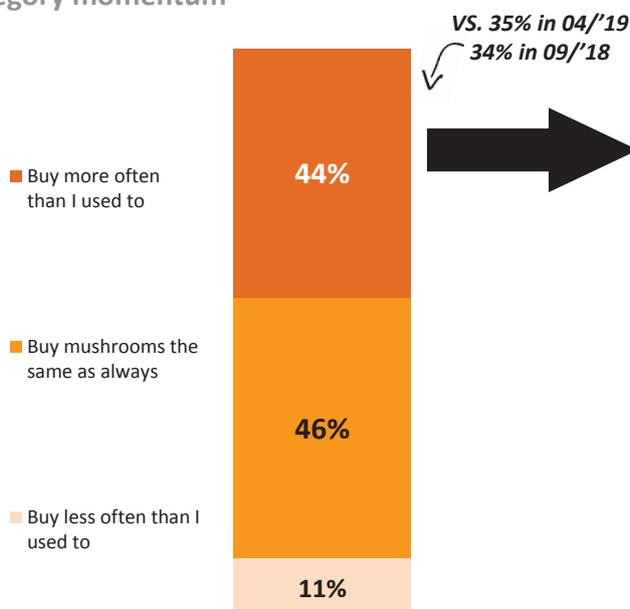


82%

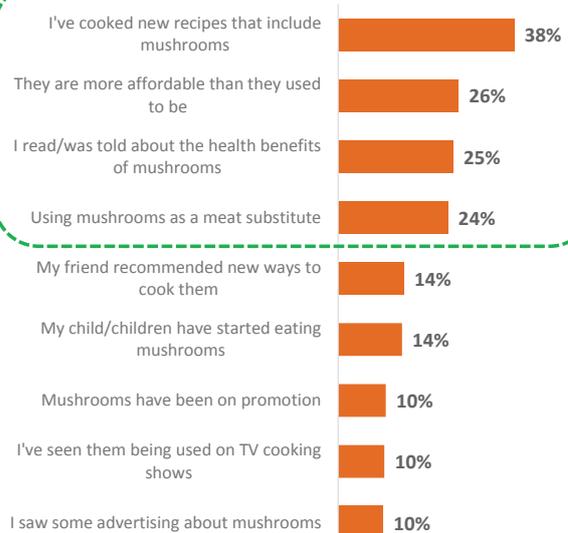
FIGURES ABOVE 75% SHOW A STRONG CATEGORY IDENTITY

## Signs that purchase frequency is growing, driven by new recipes, affordability, health benefits and a meat substitute

### Category momentum



### REASON FOR PURCHASING MORE OFTEN



THE POWER OF NEW RECIPES AS A MOMENTUM DRIVER SHOWS THERE IS A STRONG ROLE FOR DIGITAL

**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](http://horticulture.com.au)

20  
20  
CONFERENCE



Australian  
Mushroom  
Growers'  
Association

GROWING

the future, together

Save the date

14 - 17 October 2020

ADELAIDE

# KNOWING THE Health Benefits OF MUSHROOMS

If Australian mushroom growers want to know about any of the health benefits of *Agaricus bisporus*, then all they have to do is ask!

The answers can be found in the new research database developed as part of the three-year levy-funded project *Educating Health Professionals about Australian Mushrooms*.

Project Leader, Flavia Fayet-Moore of Nutrition Research Australia said the systematic literature review was now mostly complete, with 500 research papers categorised and available for use by industry on *Agaricus bisporus*.

Dr Fayet-Moore said the information could be used to support claims made through the marketing campaign, or by individual growers wanting information for a promotion or activity.

"We now have a huge amount of information specific to *Agaricus bisporus*, which is all relevant to the mushrooms grown in Australia.

As part of the project, we have implemented one of our new services, which is to keep building the database as new research is published."

"We now receive monthly alerts on new research, and we then screen the papers and add them to the database if they are relevant. Over time the database will keep growing, providing industry with an extensive research resource on health."

Dr Fayet-Moore said the project team was also working to submit the outcome of the systematic literature review to a high-ranking health journal.

"A lot of the papers on mushrooms and health have not previously appeared in high ranking journals. We want to change that, and by doing the review systematically – it will be the first every review on *A. bisporus*, and the first ever review in mushrooms that is systematic. The paper can then serve as a point of reference in further work."

## VITAMIN D WEBINAR

In keeping with the project theme for 2019, a health professional webinar was recently conducted with a focus on vitamin D. The webinar was promoted extensively through electronic mail and with advertising on the Royal Australian College of General Practitioners (RACGP) website.

Dr Fayet-Moore said the webinar attracted huge interest from health professionals with 125 registrations and 67 users for the event.

"The database for our electronic direct mail was built from personal connections, and nearly 75% of the registration came from that list of health professionals. Advertising through the RACGP also helped drive registrations and importantly gained some 37,000 impressions which help to highlight the work we are doing."

## More than just vitamin D



Alpha and  
beta glucans

Bioactive  
phytonutrients

Carbohydrate  
profile (fibrous)

Vitamin D

Ergothioneine

Flavonoids

Dr Fayet-Moore explained the webinar was very visual, with a series of easy to comprehend messages for participants.

“The event was positively received, with a lively question and answer period at the end of webinar. Where questions were posted during the webinar and not answered on the day, we are now working through a process of answering those questions and posting them to keep everyone informed.

She said a thorough approach to the post-webinar communication would ensure the content reaches a much wider audience.

“We are now sending out the website link for the webinar to those who attended and also promoting it to those who were unable to make it on the day.”

“The webinar can continue to act as a valuable resource and is available to anyone through a website link. It has also been added to the brochure that we recently developed for the GPCE conference,” Dr Fayet-Moore said.

[The webinar can be viewed at the following link: <https://www.nraus.com/blog-webinar-vitamind-2019/>]

### GP EXHIBITION AND CONVENTION

From 15-17 November the project delivered two workshops to the General Practitioners Exhibition and

Convention in Melbourne. Dr Fayet-Moore explained that the since the workshop is accredited by RACPG, the structure of the workshop prevented the presentation from being too mushroom centric and had a wider focus on vitamin D.

“The workshops were all about

vitamin D, and luckily for mushrooms the story is amazing, and we included the strong message that there is no other whole or unfortified food source that is as effective as UV exposed mushrooms to deliver vitamin D.”

**WHEN IT COMES TO VITAMIN D, TWO SOURCES ARE BEST:**

**A whole food, lifestyle approach to addressing vitamin D deficiency**

*"Did you know that Australians spend over \$100M a year on vitamin D supplements, yet 1 in 4 are vitamin D deficient? It is my pleasure to share with you the findings from a first-of-its-kind research, highlighting the importance of diet as a second source of vitamin D."*

Flavia Fayet-Moore, PhD, MNutDiet, RNutr, APD, FASLM  
CEO Nutrition Research Australia

**UNDERSTANDING THE PROBLEM IN AUSTRALIA**

**23%**  
Serum 25(OH)D < 50nmol/L

Almost 1 in 4 Australians are vitamin D deficient<sup>1</sup> results in impaired bone health

**43%**  
Serum 25(OH)D < 75nmol/L

2 in 5 Australians are vitamin D insufficient<sup>2</sup> may increase the risk of other disease outcomes

Vitamin D deficiency is also a public health problem worldwide

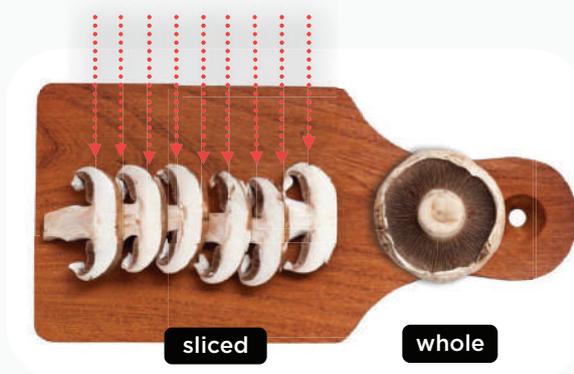
Watch the free Vitamin D webinar: [nraus.com/blog-webinar-vitamind-2019](https://www.nraus.com/blog-webinar-vitamind-2019/)

## MAXIMISING YOUR MUSHROOM'S TAN



↑ 28%-69%

Jasinghe, Food Chem. 2005;92(3)



↑ 25%

Ko, J Agri Food Chem. 2008;56(10)



“While we were able to re-adapt some of the webinar materials, it was in the format of a workshop, so we made it as interactive as possible, and delivered to attendees a four-page brochure that distilled the essence of the webinar.”

She said the workshop was extensively promoted in the leadup to the event, with advertising in the GPCE magazine allowing delegates to scan and register to attend and hear more about vitamin D.

**DIETITIANS UNITE**

The next event on the calendar is the Dietitians Unite breakfast, to be held in Melbourne in May 2020.

Dr Fayet-Moore said the event, organised through Dietitians Connection, is another fantastic opportunity to promote mushrooms to a healthcare audience.

“It has a culinary, nutrition focus, and we are expecting around 200 attendees to be on hand to hear about mushrooms.”

She explained that Australian Mushrooms would be sharing the branded breakfast event with Simplot, allowing the breakfast to deliver a wider “mushrooms and vegetables” message.

“From the project perspective our objective is to widely engage with health professionals and deliver a consistent, science-backed message, and these types of events provide the scope to do just that,” she said.

*Fun Facts*

1. Nutrition allrounder: Mushrooms not only provide nutrients found in fruit and vegetables, but also those found in meat and grains too
2. Beta-ful on the inside: The cell wall of mushrooms consists of the soluble fibre beta-glucan
3. The special sterol: While animal foods contain cholesterol, mushrooms contain a unique sterol called ergosterol, that converts to Vitamin D when exposed to light.
4. A true whole food: While the ‘cap’ of mushrooms is a richer source of antioxidants, its stem contains more of the soluble fibre beta-glucan.
5. Putting the one in ergothioneine: Mushrooms contain more ergothioneine: a unique sulphur-containing antioxidant - than any other food.
6. Devoted to vitamin D: The vitamin D content of dried mushrooms is still 50% of its original value after 18 months.

**FUN FACTS**

With the literature review primarily completed, the project continues to work to maximise the use of available health information. Given the depth of knowledge, the team has worked to distil key snippets for inclusion in the Fun Facts document.

Dr Fayet-Moore said the Fun Facts were a way of passing on a range of simple to remember messages about mushrooms and health.

“To date, we have come up with a wide range of Fun Facts, and we

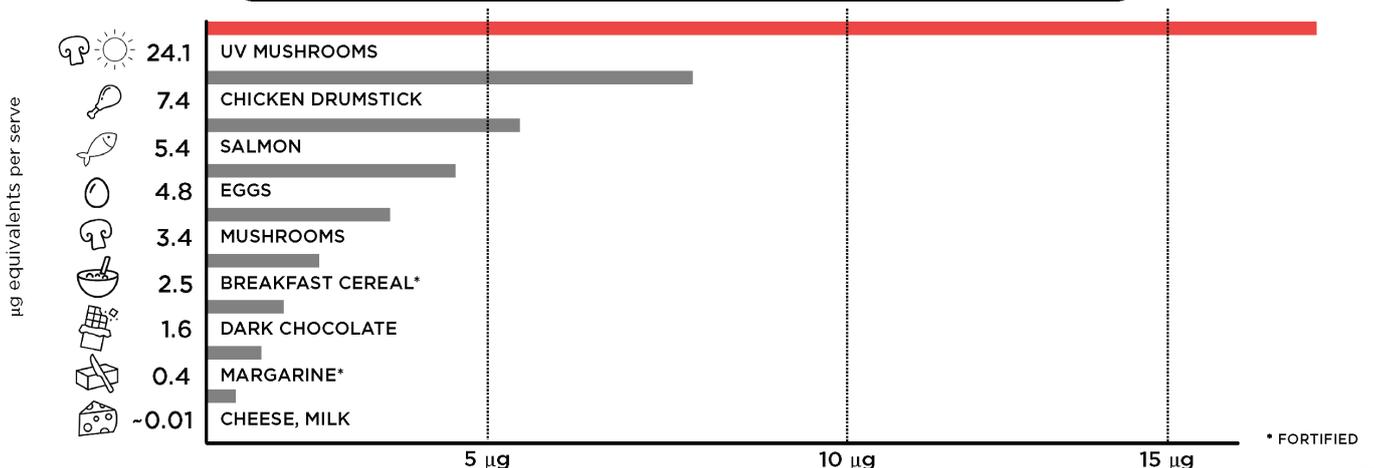
have used six so far in a range of communications, in our electronic direct mail, and our promotions for the health events.”

“We want the information to be memorable, and by turning it into Fun Facts, we have information that is clear and concise, and that can be easily passed along by health professionals,” she said.

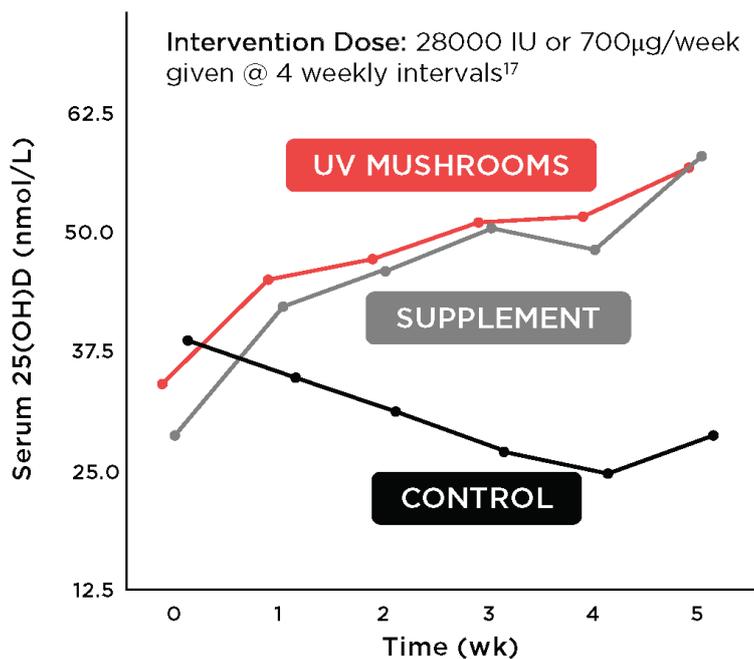
**FURTHER INFORMATION:**

*Project Leader, Flavia Fayet-Moore*  
**E** [flavia@nraus.com](mailto:flavia@nraus.com)  
**M** 0415 990 050

**THERE ARE FEW GOOD SOURCES OF VITAMIN D<sup>10,11</sup>**



# UV MUSHROOMS = SUPPLEMENTATION



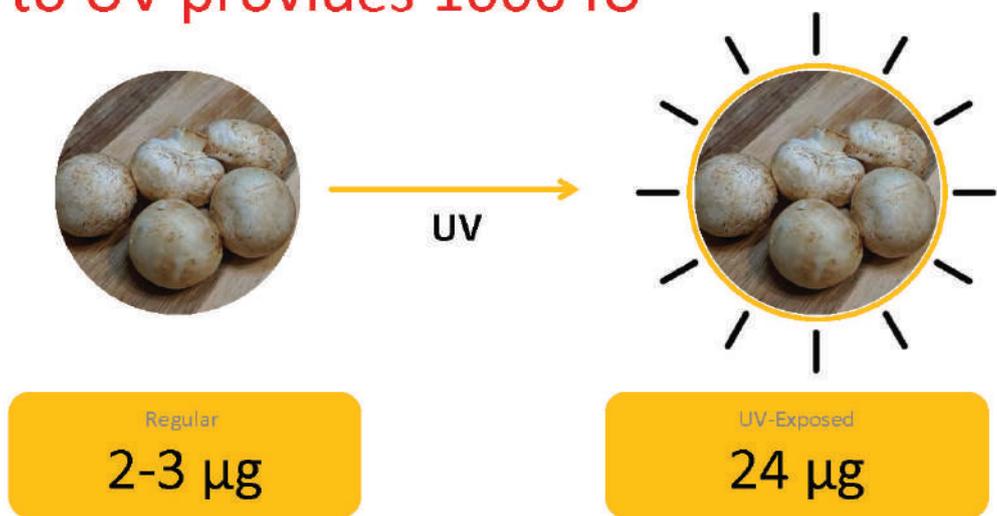
Results from a meta-analysis show that in those who are deficient, UV exposed mushrooms are as effective as supplements at increasing vitamin D levels<sup>18</sup>

Mushroom soup made with UV exposed mushrooms

Mushroom soup made with regular mushrooms plus a vitamin D pill

Mushroom soup made with regular mushrooms

## Five button mushrooms exposed to UV provides 1000 IU



*Agaricus bisporus* mushrooms have the highest ergosterol content of all culinary mushrooms

Australian Food Composition Database, Food Standards Australia and New Zealand, 2019  
 Jasinghe & Perera, Food Chem, 2005;92



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](http://horticulture.com.au)

# GROWING THE FUTURE, *Together*

There are conferences, and then there are mushroom conferences, put together specifically to meet the needs of the Australian industry.

In 2020 the mushroom industry will meet in Adelaide from 14-17 October with a conference currently being finalised under the theme – **Growing the Future - Together**.

Developed by the AMGA as a service to members and the wider industry, the conference promises to challenge and stimulate discussion, with the organising committee inviting a range of top international and Australian speakers to address delegates. The conference is funded by the AMGA with support from Hort Innovation and other industry sponsors.

Chair of the AMGA Organising Committee, Phil Rogers said the conference would be bigger and better than ever and focus on addressing critical issues facing the Australian industry.

Mr Rogers said the theme embraced the future of the industry in growing quality mushrooms in ever-greater quantity.

“The speakers we are looking to attract have many years of experience, and it is this experience that will deliver information to help us all build on the foundations that we have in place, in order to deliver a strong and vibrant industry going forward.”

The target list of speakers includes international compost experts (also covering recycled spent compost and the use of green waste in compost), a representative from the world's largest mushroom farm, a widely acclaimed Professor of Mushrooms, international mushroom consultants, experts in harvesting and in food safety and traceability, and local R&D project leaders.

Mr Rogers said he was confident the conference would deliver a

program of real interest to producers and the wider industry.

“I’m looking forward to finalising the program and outlining further topics that will be addressed by the influential international and Australian speakers. To progress as an industry, we need to access the best in the business, and that is our intention with this conference.”

“Things are hard at the moment in the industry, and we are facing a range of challenges to stay ahead. This conference is about providing a strong level of relevant information on how to address these challenges and help propel growers to the next stage and a profitable long-term future.”

The program is also expected to encompass reports on levy based investment in marketing and research and development covering a range of key projects including pest and disease management.

With farm visits being a well-regarded highlight of AMGA conferences, the committee is looking to finalise a multi-stop tour including visits to SA Mushrooms at Virginia, Revitalise Enterprises new compost facility at Port Wakefield (owned by Mr Rogers) and A1 Mushrooms (a Swiss Brown producer). The farm tour is likely to be scheduled on the first day of the program.

Mr Rogers said delegates attending the farm tour would have the opportunity of viewing state-of-the-art facilities using the latest technology.

“At Revitalise Enterprises, for example, they will see brand-new NIR analysing equipment used to track and plot differences in samples through phase 1, 2 and 3 compost. It has been in use for the past four months and is an exciting innovation that should be of interest to delegates.”

Mr Rogers said discussions were also

underway about the potential for a motorbike ride from Adelaide to Darwin.

“The mushroom industry has many very keen riders, and our previous rides [Sydney to Perth and Sydney to Mildura] have been an enjoyable part of the overall conference.”

“The suggestion at this stage is that the ride comprises a three-day trip immediately before the conference, with the return trip on the Ghan train, and with the bikes transported by truck back to Adelaide. At this stage we are just fleshing out the details, and ultimately it will depend on interest from conference participants,” he said.

Registrations for the conference will be open in early 2020. Updates on the conference programs will be made available through upcoming editions of the Journal, the Industry Update e-newsletters and special email conference Alerts.



Mushroom industry conferences are only held every two years, so take advantage of this chance to hear international experts address key topics of interest. Act now and:

- Check your diary now and block out the dates.
- Talk to your business associates, workers and others who you think may be interested and help spread the news.
- Stay informed by reading updates provided through this Journal, the Industry Update e-newsletter and special email conference Alerts.

# Diptex

## Stops Flies

Diptex provides effective control of flies in mushroom growing rooms, preventing flies from spreading mushroom diseases.

- APVMA approved for control of both Sciarid and Phorid flies
- Specific mode of action that targets fly larvae and does not harm other beneficial organisms
- No Withholding Period

**(02) 9389 8161**  
**sales@agrocare.com.au**

APVMA Approval Number: 67871/101510

# WHEN WATER RELATIONS GO BAD: NAVIGATING UNCHARTED WATERS

*Warwick Gill*

Tasmanian Institute of Agriculture  
University of Tasmania, Hobart

*Judy Allan*

Pest and Disease Management  
Service

## BACKGROUND

There are some symptoms which appear on a mushroom that are NOT caused by pests or pathogens but are a result of the reaction of the mushroom to the environment in which it is growing. Some of these environmental factors include water, temperature, carbon dioxide and relative humidity/evaporation. The environmental factors interact with the mushroom crop as a single factor, or in combination, and deviations from the optimum can result in symptoms such as poor mycelium growth and/or poor cropping, distortions, scaling, stem disorders and pale gills. What can be confusing is that some of these same symptoms could also be attributed to the presence of a disease.

The purpose of this article is to explore the biological indicators the mushroom can express and to use some specific case studies to analyse multiple and complex symptoms to pinpoint contributory factors. The acute attention to detail to symptoms expressed underpins the level of surveillance necessary to monitor for the presence of new and/or emerging disease.

## INTRODUCTION

Mushrooms comprise 90-95% water so supplying the mushroom with just the right amount of water during its growth and development is crucial to maximising quality, yield and ultimately, income. But getting the water balance 'right' can be difficult. Water relations within a mushroom bed is a complex interplay of compost moisture, casing moisture and atmospheric relative humidity [RH]. Mushrooms do not have a waxy layer or protective skin like fruits and other veg-

etables, so achieving the correct water balance is difficult as water is easily lost and absorbed through the cap and stem tissues.

When a water imbalance does occur, affected mushrooms express a physiological response as a water stress symptom. Water stress symptoms may affect up to 100% of a crop, resulting in a significant drop in yield and quality. However, by looking closely and carefully at the expressed symptom, the grower will often be able to isolate where the imbalance is and when the problem occurred.

Mushrooms obtain water from both casing and compost. Unfortunately, there is no single industry-wide formula to determine the optimal moisture content of each component as farms run different cropping systems with different compost and casing compositions of different water holding capacities and different water availabilities. However, what is consistent is that when there is a breakdown in water relations, the mushrooms will tell you where it is.

This article introduces some common causes of water stress in the mushroom cropping system, illustrates the symptoms expressed by affected mushrooms and outlines the contributory factors which must be investigated and addressed in order to correct them. Look closely at what your mushrooms are trying to tell you, 'interpret the message' and act accordingly.

## THE COMPOST AND CASING - MUSHROOMS' FOOD AND DRINK

In its vegetative stage, the growth of mushroom mycelium through the compost and into the casing is relatively slow. However, when it switches to reproductive growth within the casing, the mushroom enters a rapid expanding stage [RES] of pin development, when the mushroom may double its size every 24 hours. It is during the RES that the mushroom is extremely sensitive to any change in environment and nutrition and because it is during this growth phase that fruit quality is largely determined,

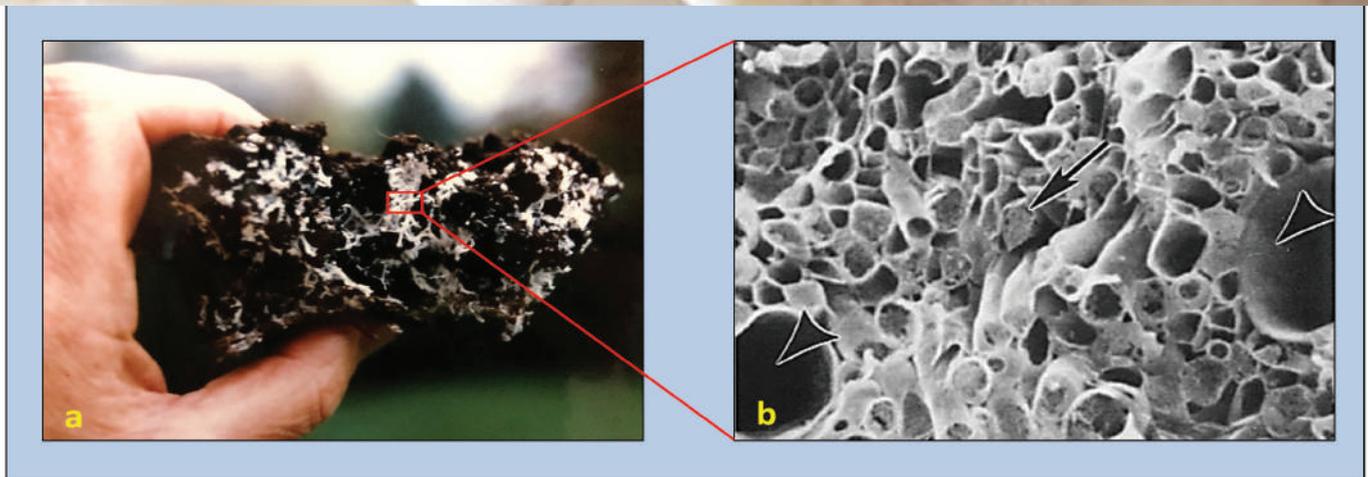
an imbalance in water relations and nutrient availability at this stage will severely impact yield and quality.

The mycelium of *Agaricus bisporus* absorbs water from both the compost and casing to nourish the fruitbodies. Approximately 54-83% of water is derived from the compost while the casing layer contributes 17-46% depending on flush, casing thickness and harvesting time, but both layers are important in the water supply to the mushrooms [Kalberer 1990].

The transportation of dissolved nutrients and water occurs through a fine network of 'pipes' consisting of mushroom mycelium, which is laid down as the spawn runs through the compost. When the mycelium migrates into the casing, larger capacity 'pipes' or rhizomorphs [Fig. 1] are produced which supply the developing pins during the RES. It is therefore critical that the mushroom is provided a steady environment and a consistent and optimal watering regime to deliver the correct balance of compost nutrition, temperature and optimal compost and casing moistures. Initially, this will allow a healthy and robust 'pipe' network to establish but equally as important, it will keep the 'pipes', particularly the casing rhizomorphs, in good working order. But an under-supply or over-supply of water, or inconsistent watering will damage the network and prevent optimal amounts of nutrients and water reaching the developing mushrooms.

## READ THE MUSHROOMS; INTERPRET THE PROBLEM

A particular water imbalance will generally cause similar symptoms to be expressed in affected mushrooms. Table 1 introduces some of the common symptoms of water stress and the imbalance in the cropping system that causes them. Photographs are provided to assist in identifying the symptoms that may be seen on the bed. However, the list is by no means exhaustive. As demonstrated later, extreme symptoms do occur. But by carefully analysing even multiple and complex symptoms, the most likely root cause can be identified.



**Figure 1** *Agaricus* rhizomorphs in casing **a**) the network of thick white rhizomorphs within the casing layer **b**) in cross section, the rhizomorphs are seen to be composed of regular hyphae (arrow) and large 'vascular' hyphae (arrowheads) which transport water and nutrients. Photo credits: a) courtesy of Hans Tschierpe; b) Heckman et al (1989) courtesy of JSTOR

## EXTREME WATER STRESS SYMPTOMS

### Case 1

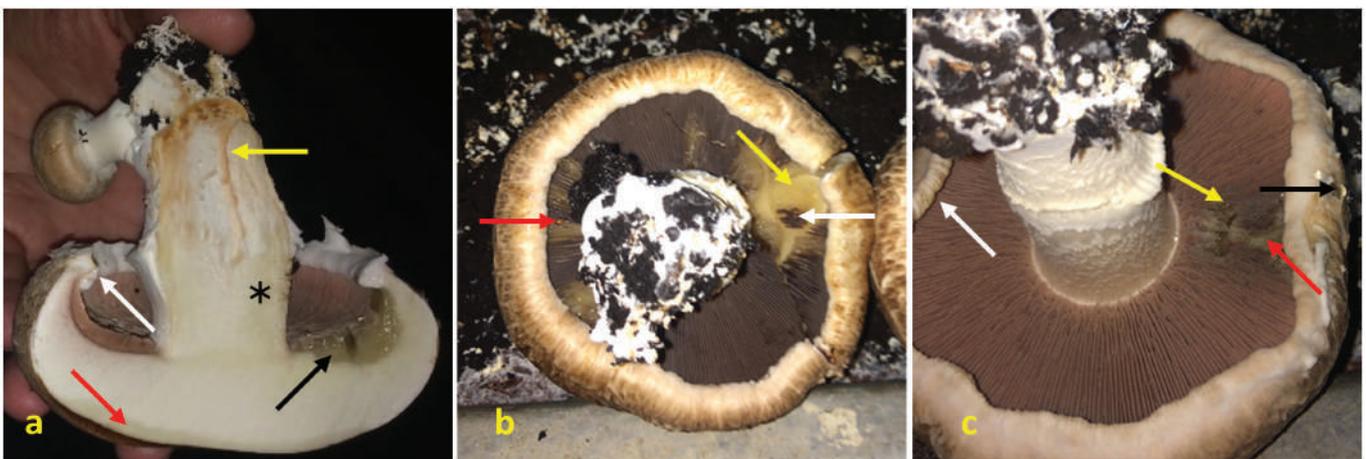
In December 2018, the Project Team received an email from a grower describing unusual symptoms expressing on brown *Agaricus* mushrooms. In the email, the grower forwarded some excellent photographs illustrating the problem very clearly [Fig. 2a-c] and sent some affected mushrooms to the Tasmanian Institute of Agriculture for further investigation. From the photographs, the most characteristic symptom appeared to involve disruption of the gill tissue, so the disease 'drippy gill,' caused by *Pseudomonas agarici*, was the first consideration. However, after closer analysis of the photographs and studying symptomatic mushrooms, 'drippy gill' was eliminated as a possibility by the logical reasoning presented in Table 2. The symptoms were determined

to be caused by water stress.

In this case, the occurrence of symptomatic mushrooms was widespread, affecting a significant proportion of the crop and became more severe as the crop matured. Furthermore, the problem had been expressing for three weeks, so was not an isolated case confined to a substrate microclimate. By referring to Table 1, the major symptoms – weeping, water-logged stems and watery flesh – appear to be consistent with mushrooms growing in wet casing over a dry compost. Water stress and an imbalance in water relations was diagnosed from these unusual and extreme symptoms.

In the affected mushrooms, symptoms were expressed in tissues in close proximity to the path of water transport [Fig. 3a] which was identified by Schütte in 1956 [Fig. 3b]. Both the stem and cap immediately above the gills were heavily

waterlogged and the nearby cap tissue became discoloured. Water droplets issued from the edge of the cap, which is at the end of the water transport pathway and would be consistent with the 'overloading' of this system. An unusual 'jelly'-like material also formed close to the path of water transport and appeared to be caused by the swelling of the sub-hymenium, the tissue which gives rise to the gills. From light microscope examination, the 'jelly' was in fact seen to be composed of water-soaked, swollen, non-differentiated hyphal cells and was not the amorphous jelly that it initially appeared to be. Water-logging of the sub-hymenium prevented normal gill development and the turgid sub-hymenium became visible because it was swollen and the normally overlying differentiated gill tissue was absent.



**Figure 2** Photographs of symptomatic mushrooms received by the Project Team **a**) water-logged and discoloured stem tissue (yellow arrow) with free water sitting on the cut surface (\*), a 'window' of water-soaked cap tissue (red arrow), yellow 'jelly' (black arrow), in-rolled margin (white arrow) **b**) clear brown water droplets on the gills (red arrow), water-soaked but otherwise healthy gill tissue (white arrow) and yellow 'jelly' (yellow arrow) which displaces the gills in places **c**) in-rolled margin (white arrow), issuing droplets from the healthy-looking gills (yellow arrow) despite being close to the 'jelly' (red arrow), clear water droplets issuing from the outer cap (black arrow). The stipe is outwardly asymptomatic. Photo credit: Supplied by farm

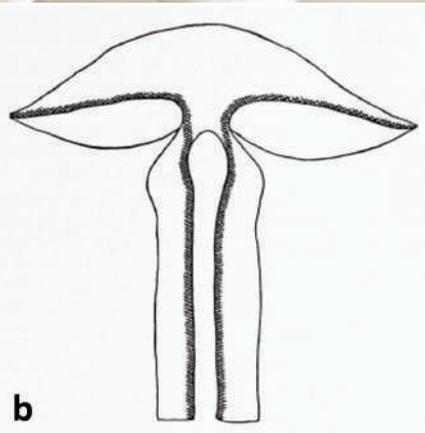
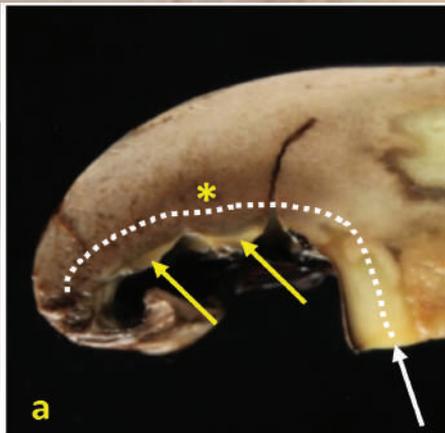
**Table 1** Summary table of water-related disorders

Symptom	Contributory factor(s) and comments	Example
1. Premature opening	<p>Casing and compost moisture and nutrition</p> <ul style="list-style-type: none"> <li>• Can express after heavy 1<sup>st</sup> flush results in a dry casing</li> <li>• Can express when high CO<sub>2</sub> levels occur in the microclimate. Too many pins are formed and picking management is not able to provide room for the mushrooms to grow and the compost heat to escape</li> </ul>	
2. Leggy mushrooms	<p>CO<sub>2</sub> levels and casing moisture</p> <ul style="list-style-type: none"> <li>• Common in dry casing. Can express when mushrooms grow in a crowded microclimate and CO<sub>2</sub> builds up and metabolic heat from the compost and mushrooms can't escape</li> <li>• When caps show a 'helmet' symptom, presence of virus disease should be explored</li> </ul>	
3. Split stems	<p>Casing and compost moisture</p> <ul style="list-style-type: none"> <li>• Can express in mushrooms grown in wet casing on wet compost</li> <li>• Can also be triggered by the watering regime between flushes</li> <li>• Mushroom cap and stem both high in moisture content</li> </ul>	
4. Saggy socks	<p>Casing and compost moisture and evaporation</p> <ul style="list-style-type: none"> <li>• Commonly triggered in mushrooms growing in between 1<sup>st</sup> and 2<sup>nd</sup> flush when a large amount of water is applied and the mushrooms grow unevenly when growth and evaporation rate (water out) can't keep up to water in the bed</li> </ul>	
5. Susceptibility to bruising	<p>Casing and compost moisture and evaporation</p> <ul style="list-style-type: none"> <li>• Mushrooms that are damp to touch and NOT white indicate lack of evaporation or water stress from a dry casing</li> <li>• Bruising occurs due to mechanical damage during harvesting, packing and transport</li> </ul>	
6. Internal watery blemishes ('windows')	<p>Casing and compost moisture and evaporation</p> <ul style="list-style-type: none"> <li>• Prevalent in wet casing on dry compost</li> <li>• A symptom of lack of evaporation</li> </ul>	
7. Wet stems	<p>Casing and compost moisture and evaporation</p> <ul style="list-style-type: none"> <li>• Result of an imbalance between excessive water uptake of the mushroom fruitbody over water loss</li> <li>• Mushrooms watered late in their development susceptible to uneven water distribution and excessive water in the stem</li> <li>• Increased compost temperature, e.g. as a result of compost activity when 2<sup>nd</sup> flush is pinning, can lead to wet stems expressing</li> </ul>	

**Table 1** Summary table of water-related disorders (cont...)

Symptom	Contributory factor(s) and comments	Example
<b>8. Brown core</b>	<p>Casing moisture and evaporation</p> <ul style="list-style-type: none"> <li>Lack of evaporation when the pinheads are developing into mushrooms</li> <li>This particular photo is of an early formed 1<sup>st</sup> flush mushroom so the room conditions were understandably being managed for the majority of the flush and therefore the humidity and evaporation were not ideal for early mushrooms</li> </ul>	
<b>9. Weepers</b>	<p>Casing and compost moisture</p> <ul style="list-style-type: none"> <li>Often occurs in wet casing on dry compost</li> <li>Water droplets can also be seen on the stem of affected mushrooms</li> <li>Interpreted as a stress symptom when more water is pumped into the mushroom than is evaporated out</li> </ul>	
<b>10. Hollow stem</b>	<p>Casing moisture</p> <ul style="list-style-type: none"> <li>Occurs in wet casing on dry compost</li> <li>The whole mushroom is very wet</li> <li>May occur following period of excessive water uptake followed by a period of rapid evaporation</li> </ul>	
<b>11. Scaly caps</b>	<p>Air flow and humidity</p> <ul style="list-style-type: none"> <li>Occurs when humidity is low, or air velocity is excessive</li> <li>Beware that too low air flow may result in bacterial blotch expressing</li> <li>If a 'harsh' drying phase is initiated, mushrooms can express symptoms of both scaling from a lot of evaporation over a short period of time and blotch from not enough evaporation at other times</li> </ul>	
<b>12. Misshapen, irregular or asymmetrical cap development</b>	<p>Casing moisture and evaporation</p> <ul style="list-style-type: none"> <li>Commonly triggered in mushrooms growing between 1<sup>st</sup> and 2<sup>nd</sup> flush when a large amount of water is applied and the mushrooms grow unevenly when growth and evaporation rate (water out) can't keep up to water in the bed</li> <li>Small pins can be damaged by the picking process or if beds are 'cleaned' by the pickers</li> <li>Asymmetrical cap development may indicate presence of high numbers of nematodes</li> </ul>	
<b>13. Internal stipe necrosis</b>	<p>Casing moisture</p> <ul style="list-style-type: none"> <li>Occurs chiefly in very wet casing</li> <li>Often occurs with a corky stem core tissue</li> <li>Characterized by browning of water conductive stem tissue</li> <li>Generally thought that the bacterium <i>Ewingella americana</i> is responsible for the browning but this may be due to physiological deterioration of water-soaked tissue</li> <li>This disorder needs more investigation</li> </ul>	
<b>14. Mycelium overgrowth</b>	<p>Casing moisture and evaporation</p> <ul style="list-style-type: none"> <li>Surface growth of the mycelium is important to ensure water can penetrate into the compost</li> <li>Where the casing surface is 'sealed' by mycelium, water will collect on the top so total water applied will be reduced, leading to water stress</li> <li>Overgrowth will reduce pinning and cause pin death</li> </ul>	

Photo credits: J. Allan 2, 4, 5, 6, 7, 8, 11, 12; 14; W. Gill 9, 13; Fletcher & Gaze (2008) 1, 3, 10



**Figure 4** In-rolled margin and wavy gills often expressed by affected mushrooms. Note asymptomatic stem. *Photo credit:*

**Figure 3** Water movement through mushrooms **a)** path of water movement through a water-soaked mushroom (white arrow and dotted line) surrounded by browning water-soaked cap tissue (\*). Yellow 'jelly' has displaced gill tissue (yellow arrows) **b)** Cross-section of a typical *Agaricus*-type mushroom indicating the region of water transport (hatching). *Image credits: 3a, W. Gill; 3b, Schütte (1956) courtesy of JSTOR*



**Figure 6** A weeper that has become a 'stinker'. *Photo credit: W. Gill*

It is likely, too, that the wavy gills and in-rolled margin [Fig. 4] are also due to the swelling of the sub-hymenium as the increased cellular volume and consequent increased length would distort the overlying tissue to fit into the predetermined space between the stipe and cap margin.

### Case 2

This 'bleeder' [Fig. 5] is a very extreme example of a water-stressed mushroom involving multiple bacterial infections, one of which gives the mushroom the appearance of bleeding. Bacteria producing red pigments such as *Serratia marscesens* are known to inhabit mushroom casing. In addition to the obvious weeping symptom, the white *Agaricus* mushroom showed slight scaling of the cap and was generally 'off-white' in colour. Referring to Table 1, the weeping symptom is due to mushrooms growing on a wet casing over a dry compost while the scaling and browning would be caused by low humidity or excessive air velocity. As this was a solitary example, this symptomology is indicative of an isolated and very localised microclimate such as an overly dry or overly wet patch of casing and/or compost and exposure to high air flow, perhaps near a vent or outlet. Weepers are more likely to be brown strains than white, so this is an unusual occurrence for that reason alone. Isolated examples like this are a curiosity and are not necessarily indicative of wholesale water imbalances across the cropping system.

### Case 3

An extraordinary example of an *Agaricus* brown strain weeper [Fig. 6]. The weep-



**Figure 5** The 'bleeder', a complex of pathologies. *Photo credit: J. Allan*

er has exuded water around the base of the stem where it has begun to form a foul smelling 'foam' and has become a 'stinker'. The cause of the foam is not known, but due to the odour produced, it is likely to be a biological fermentation. Alternatively, the mushroom 'sap' may have reacted with something in the casing such as lime, to create this reaction, but this does not account for the odour. Again, this was an isolated example and did not recur after the crop ran its course and the room was cooked out. Presumably this symptomology was elicited by a substrate microclimate of a patch of wet casing overlying a dry compost. There has been a recent report of this exact phenomenon occurring at another Australian farm. Wuest [1982] differentiates weepers into three distinct categories: the 'leaker', where water droplets form and remain on the cap and stipe, the 'weeper' where the droplets form and then fall from the mushroom onto the casing and the 'stinker' which occurs when a weeper dissolves into a

white, putrid foam or when the water from a 'weeper' collects on the casing and a malodorous foam forms such as in this example.

### CONCLUSION

Ever since the widespread adoption of hybrid *Agaricus* strains and denser 'deep-dug' black peat as the primary casing component, water relations in mushroom growing have shifted. As the mushroom growing bed has become wetter and the growing environment more humid, more environmental-mediated abiotic disorders expressing novel symptoms have emerged.

Furthermore, the wetter conditions also favour some pathogenic fungi such as *Cladobotryum* [Cobweb disease] and the appearance of new and emerging bacterial diseases, such as the soft rots and the internal stipe necrosis bacterium, are closely correlated with the wetter growing regime. In addition to the new and emerging pathogens, previously known pathogens are 're-emerging' and

**Table 2** Symptomatic mushroom and drippy gill symptoms compared

Symptom	Symptomatic mushroom	'Drippy gill'-affected mushroom
Water-logged stem Fig. 2a; Fig. 3a	Heavily water-logged, free water observed on cut surface of stem	Not water-logged. Stem is dry and splits longitudinally, exposing central stem core tissue. Splits may exude bacteria as infection develops
Water-logged cap tissue Fig. 2a; Fig. 3a	Water-logging forms 'windows' in the cap tissue	Cap tissue shows no signs of water-logging
'Jelly-like' material in gills Fig. 2a-c; Fig. 3a	Develops in the sub-hymenium and protrudes through hymenium. Replaces gill tissue in affected areas, or locally prevents formation of the gill tissue	'Jelly-like' material not observed in 'drippy gill'-affected mushrooms
In-rolled margin Fig. 2a,c; Fig. 4	Margin heavily in-rolled	Margin not affected
Water droplets on gills Fig. 2b,c	Clear water droplets were exuded close to the yellow 'jelly'	Droplets exude from the gills and splits in the stem. The droplets are opaque and composed of bacteria and they coalesce and form 'ribbons' of slime when they touch
Water droplets at cap periphery Fig. 2c	Leaking/weeping. More frequent on brown strains than white. Droplets on the outside edge of the caps are transparent, indicating no bacterial infection. Not seen on stipe or central cap	Droplets do not form on the exterior of the cap
Wavy gills Fig. 4	Gills wavy, no evidence of tissue collapse or necrosis	Gills are disrupted, become necrotic and collapse. Deteriorate and rot, do not become wavy
Time of symptom expression	Express while mushrooms are still closed	'Drippy gill' symptoms may be expressed before veil break <sup>1</sup> while the mushroom is still closed

<sup>1</sup>Early workers assumed that *P. agarici* bacteria existed within the mushroom hyphae because symptoms were expressed before veil break, before the hymenium was exposed to compost bacteria. In *A. bisporus*, the veil is a double membrane, which makes it even more unlikely that pathogenic bacteria from the compost or casing would be able to access the hymenium prior to veil break. It has since been demonstrated (Gill & Cole 2000) that 'drippy gill' bacteria migrate through the cap tissue to the hymenium and fall from the gills in droplets. They also migrate through the cap tissue to the stipe and exit through the split stipe. Bacterial migration is driven by gravity

expressing symptomology not previously attributed to them as they adapt over time to the wetter growing environment. Such an example is *P. agarici*, the causal organism of drippy gill disease. Recent reports of this bacterium from Serbia indicate that the primary symptom is now not the classic bacterial droplets issuing from necrotic gill tissue and longitudinally split stipes, but a browning symptom which is considered to be a greater problem than that attributed to brown blotch caused by *Pseudomonas tolaasii* [Milijaevi-Mari *et al* 2016].

Don't wait for a major problem to arise before reviewing your watering regime. If left unchecked, an imbalance in water relations within the mushroom cropping system can have a significant detrimental impact on yield, quality and ultimately farm profitability. By looking carefully and looking closely at the symptoms expressed and referring back to the symptom summary table [Table 1], the problem can be identified, isolated and rectified.

And lastly, a quote which concisely sums up the theme of this article:

"Finally, growers must read the mushrooms, it's growth, its stress symptoms and react to what they are telling you".

David Beyer [2001]

### GROWERS' SUMMARY

- Not all symptoms expressed on mushrooms are caused by pathogens. Learn to distinguish common water stress-induced symptoms from disease symptoms.
- Many symptoms are biological indicators. They are reactions to a sub-optimal environment and are often water related.
- Multiple or complex symptomologies may have multiple roots. Identify the separate symptoms. Refer to Table 1 and determine the cause of one symptom at a time.

- Look very carefully and accurately interpret what the mushrooms are telling you. Act accordingly.
- If you observe a symptom you cannot identify or explain, photograph it in situ and contain or remove the symptom. Contact the Project Team with the photographs to develop a plan of action.
- Analysing symptoms very closely and paying acute attention to detail are fundamental to effective monitoring for new and/or emerging diseases.

### FURTHER INFORMATION:

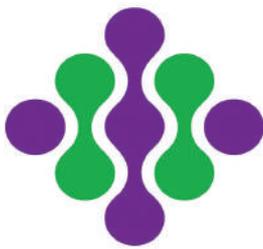
Project Leader, Warwick Gill  
**E** warwick.gill@utas.edu.au  
**M** 0417 766 588

Pest & Disease Service, Judy Allan  
**E** judyallan@bigpond.com  
**P** 02 6767 1057

## KEY REFERENCES

Beyer D [2001] Casing management and mushroom quality. *AMGA Journal* Summer:8-12 | Beyer D [2001a] Casing water: characteristics and behaviour. *AMGA Journal* Autumn:6-9 | Fletcher JT, Gaze RH [2008] *Mushroom Pest and Disease Control: A Color Handbook*. Academic Press | Gill WM, Cole T [2000] Aspects of the pathology and etiology of 'drippy gill' disease of the cultivated mushroom *Agaricus bisporus*. *Canadian Journal of Microbiology* **46**:246-258 | Heckman CA, Pelok SD, Kimpel SA, Wu LC [1989] Scanning electron microscope studies on fruitbody primordium formation in *Agaricus bisporus*. *Mycologia* **81**:717-727 | Kalberer PP [1990] Water relations of the mushroom culture *Agaricus bisporus*: study of a single break. *Scientia Horticulturae* **41**:277-283 | Milijasevic-Marcic S, Todorovic B, Stepanovic M, Duduk B, Stepanovic J, Rekanovic E, Potocnik I [2016] Monitoring of bacterial diseases of *Agaricus bisporus* in Serbia. *Pesticides and Phytomedicines* [Belgrade] **31**:29-35 | Noble R, Dobrovin-Pennington A [2000] Determining the causes of mushroom water stress symptoms. Final Report of Project M35, Horticultural Development Council | Schütte KH [1956] Translocation in the fungi. *New Phytologist* **55**:164-182 | Wuest PJ [1982] Penn State Handbook for Commercial Mushroom Growers. The Pennsylvania State University

## MU16003 - Pest and Disease Management and Research Services



**tia**  
TASMANIAN  
INSTITUTE OF  
AGRICULTURE

**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](http://horticulture.com.au)

## Phase 1,2 & 3 Compost Yard Manager.



**SA MUSHROOMS**  
*delicately hand picked*

South Australia Mushrooms is seeking an enthusiastic, experienced and reliable compost yard manager to run a brand new modern 9 tunnel facility in Adelaide, South Australia. The successful candidate will be responsible for all aspects of producing high quality Phase 1,2 & 3 mushroom compost.

### The successful applicants will have the following skills and attributes:

- Experience in running modern 9 tunnel facility
- Excellent communication
- The ability to coach and develop team skills
- Experience supervising others
- Full time position

South Australia Mushrooms is a fully integrated family owned business with its own compost yard, mushroom farm and wholesale Market stand. This ensures the highest standard in quality and reliability to staff and customers possible. There are many world class schools and universities in Adelaide. For more information on our beautiful sunny state of South Australia, please see [www.southaustralia.com](http://www.southaustralia.com)



Please email your CV to  
[nick@samushrooms.com.au](mailto:nick@samushrooms.com.au)

# WHEN PUSH COMES TO SHOVE: REDUCE SUSCEPTIBILITY TO BRUISING

*Warwick Gill*

*Tasmanian Institute of Agriculture,  
University of Tasmania, Hobart*

## SUMMARY

Bruising is a common cause of mushroom discolouration leading to a reduction in quality and loss of marketable fresh product. Although mushrooms are prone to bruising because of their innate structure and biomechanics, some cultural practices have been shown to reduce the susceptibility of mushrooms to bruising. By analysing the interaction of casing moisture and composition, room humidity and flush number, growers may be able to make small agronomic changes which will reduce the susceptibility of their mushrooms to bruising. With 97% of Australian-produced mushrooms sold in the highly competitive fresh market, any reduction in discolouration will reap benefits.

## INTRODUCTION

For mushrooms in the fresh market, quality is determined by colour, texture, cleanliness, maturity and flavour. Of these, the most important is colour. Any sign of discolouration will determine whether or not customers purchase mushrooms from the store and it is also the reason for the majority of supermarket rejections.

To be acceptable, white button

mushrooms must be uniformly white and free from any signs of browning, which is obvious against the white background of the mushroom. Browning is perceived by the customer as a sign of age and microbial spoilage and therefore low quality and undesirable product. It takes only a few discoloured mushrooms (Fig. 1) to downgrade a whole box in the eyes of a potential purchaser.

Browning occurs when three mushroom cell components – tyrosinase, a phenolic substrate and oxygen – are combined. A chain of biochemical reactions takes place, resulting in the production of melanin, a dark brown pigment. Under

normal conditions, these compounds are separated by membranes into different compartments within the mushroom cell. But when the cell structure is broken down, the three compounds mix and the browning process, called melanisation, begins.

For a full description of this process, take a look back at the technical note written earlier this year in the *Australian Mushrooms Journal*.

Browning is caused by senescence, the natural physiological deterioration that begins immediately after harvest.



**Figure 1** Bruising-induced browning on harvested mushrooms

Photo: Judy Allan

Browning may also occur as a disease symptom, such as brown blotch caused by *Pseudomonas tolaasii*, but browning is most commonly caused by bruising resulting from mechanical damage during harvesting, packing and transport.

## BRUISING

Bruising occurs in most horticultural crops but because mushrooms are very fragile and lack the protective waxy cuticle and thick skin of other fruits and vegetables, they are highly susceptible to bruising.

Bruisability is not related to texture or firmness but is an upshot of the mushroom cap structure and how the hyphal cells are arranged. In cross-section, the mushroom cap is composed of three distinct zones (Fig. 2).

On the outside is the very thin 'skin' layer, a lattice network of hyphal cells designed to withstand lightweight impact and to be flexible as the mushroom cap expands. Immediately beneath is a zone of low-density, loosely packed hyphae containing large air spaces which assist in absorbing low energy impacts, while the third layer, which makes up the bulk of the mushroom cap, comprises densely packed mushroom hyphae.

Bruising, as described by Burton (2013), occurs when a 'slip-shear' force (a downward force with a sideways movement) is applied to the surface of the mushroom. The outer

skin cells are pushed into the loosely packed layer below with a downward force or impact and then the cells of the second layer are ruptured as a sideways motion slides them across the unyielding dense tissue below. The phenolic substrate and tyrosinase inside the ruptured cells are released and react with oxygen, resulting in browning.

Because the cells in the outer layers of the cap contain the greatest concentrations of phenol and tyrosinase in the mushroom, mechanical damage to the skin and outer layers results in a rapid, intense and obvious brown bruise. Mushrooms may be subjected to 'slip-shear' forces by pickers during harvesting, when they rub against each other during transport, when they are squashed into a box beneath a lid and when the boxes are badly stacked in the back of a truck.

## REDUCING SUSCEPTIBILITY TO BRUISING

Susceptibility to bruising varies between crops and even within a crop. Some mushrooms can bruise at the slightest touch while others seem almost bullet proof. Because mushrooms of the same crop are of the same strain, they are genetically identical. The variability in bruisability cannot therefore be related to genetic differences.

Kerry Burton, then of Horticulture Research International, Wellesbourne, United Kingdom undertook extensive

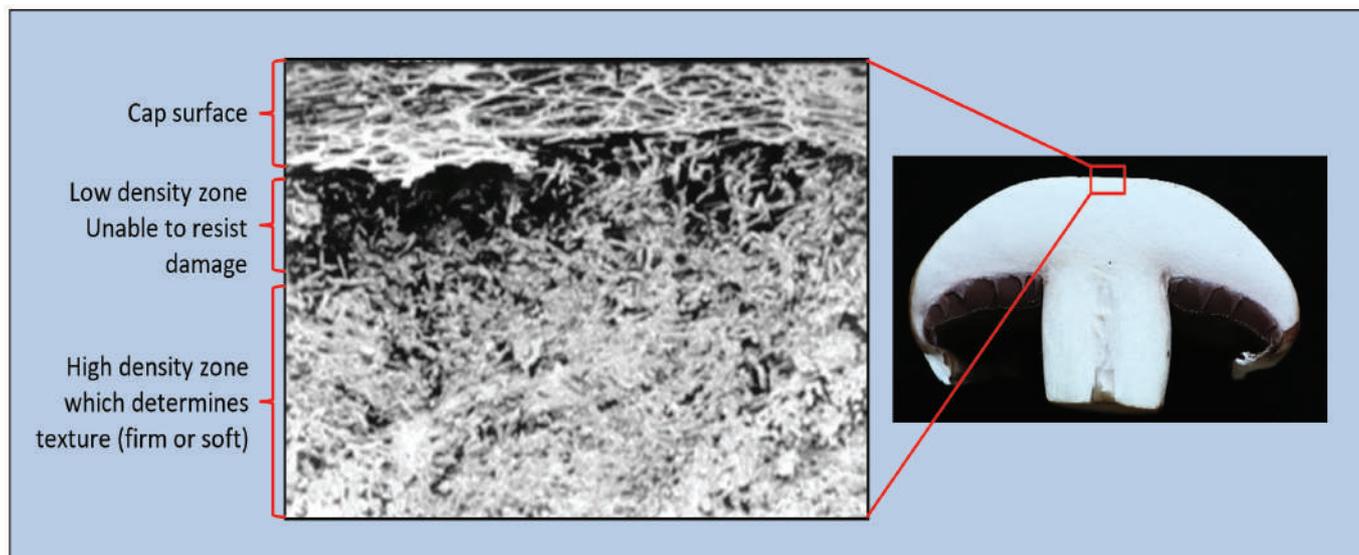
studies on mushroom bruising, inventing a 'bruisometer' to repeatedly and consistently apply a known force to mushrooms to inflict a reproducible bruise. With the 'bruisometer' he was able to investigate what influence growing conditions, both environmental and agronomic, play in the susceptibility of mushrooms to bruising.

Burton (2002a) discovered that the flush number, casing moisture and room humidity all play highly significant roles in increasing resistance to bruising (Table 1).

First flush mushrooms growing on wet casing bruise less than first flush mushrooms growing on medium or dry casing. For second flush mushrooms, the casing water content does not affect bruising susceptibility. But third flush mushrooms growing on dry casing bruise less than third flush mushrooms growing on medium casing. These mushrooms in turn bruise less than third flush mushrooms growing on wet casing.

In terms of room humidity, first and second flush mushrooms growing in high humidity (92%) bruise less than first and second flush mushrooms growing in low humidity (85%). Neither high nor low humidity affect the bruisability of third flush mushrooms.

Three further cultural factors exert a minor influence on bruising susceptibility. The composition of the casing has a small but significant



**Figure 2** A scanning electron micrograph showing how the structure of the upper layers of the mushroom cap make it vulnerable to mechanical damage and bruising. *Figure adapted from Burton (2013)*

**Table 1** Environmental and agronomic factors shown to affect mushroom bruising

Factor	Relative importance	Factor	Relative importance
Water potential of casing	●●●	Compost type	●
Growing room humidity	●●●	Compost depth	—
Casing depth	●●	Flush	●●●
Casing composition (% SBL)	●	Strain	●●●

●●● large influence on bruising; ●● medium influence on bruising; ● low influence on bruising; — no effect on bruising

*Adapted from Burton (2002a)*

effect. Mushrooms growing on dry casing composed of 30% sugar beet lime (SBL) bruise less than those grown in 9% SBL. The difference in casing composition does not affect yield.

Burton [2002] further showed that second flush mushrooms growing on a shallow casing [25mm] are less prone to bruising than those growing on a deep casing [55mm], but casing depth has no such effect on first and third flush mushrooms.

Although the depth of compost has no influence on bruising, less degraded, more 'strawy' composts reduce bruising compared to darker, more degraded composts.

Finally, the mushroom strain grown is also highly significant and selecting the best strain to be grown is critical to minimise bruising [Burton *et al* 2003]. However, strain choice is made on the expression of multiple characteristics which are considered desirable by the grower and not on a single trait such as reduced bruising. As Burton [2002a] cautioned, changing strain may reduce bruising and therefore improve quality, but it may also make matters worse!

### THE BATTLE AGAINST BRUISING - NON-BROWNING MUSHROOMS ARE NEARLY MARKET-READY

A new gene editing technology has been developed called CRISPR [Clustered Regularly Interspaced Short Palindromic Repeats] which has led to the development of non-browning mushrooms. Researchers at Penn State University have identified many of the genes which regulate the browning process and have cut them out of the mushroom genome.

Consequently, the mushroom can no longer produce melanin and does not brown even after slicing. Furthermore, because the scientists have not inserted DNA from another organism, the non-browning mushroom is not considered a genetically modified organism (GMO) by the United States Department of Agriculture and is not subject to the rigorous risk assessment and approval process that transgenic GMOs must go through.

In addition to extending mushroom shelf life, it is hoped that the non-browning mushroom will allow mechanical harvesting systems to be used on mushrooms destined for the fresh market, which is currently handpicked, incurring high labour costs. Robotic harvesters work at up to 400 times the capacity of manual harvesters, but because they severely bruise the mushrooms, mechanically harvested mushrooms are currently fit only for canning and processing.

The researchers have made no comment on the impact of non-browning mushrooms on expression of diseases such as brown blotch.

Without melanin production, the blotch symptom will not be expressed so brown blotch may be a disease of the past. Yet browning is also a defence mechanism, as melanized tissue prevents infection by bacteria. What will happen if *P. tolaasii* is allowed free access to the interior of mushroom caps?

Read about non-browning mushrooms at:

<https://agsci.psu.edu/magazine/articles/2016/fall-winter/a-crispr-mushroom>

<https://news.psu.edu/story/432734/2016/10/19/academics/penn-state-developer-gene-edited-mushroom-wins-best-whats-new>

### CONCLUSION

The main cultural factors which influence bruising susceptibility are concerned with water (casing moisture, humidity and casing depth).

But because no two farms are identical, it is not possible to offer one singular course of action that will reduce susceptibility to bruising on every farm.

Each farm runs different compost and casing formulations and runs to a unique schedule.

Changing watering patterns to reduce bruising susceptibility may well increase quality, but will also alter pinning times, harvest schedules and other crop management parameters.

Changes must be assessed carefully by individual farms and undertaken with caution.

However, because in Australia 97% of mushrooms produced are supplied to the fresh market, a small reduction in the frequency of bruised mushrooms will bring significant gains in these times of tight margins and intense competition in the marketplace.

### FURTHER INFORMATION:

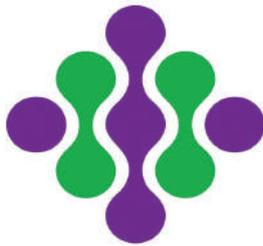
*Project Leader, Warwick Gill*  
**E** warwick.gill@utas.edu.au  
**M** 0417 766 588

*Pest & Disease Service, Judy Allan*  
**E** judyallan@bigpond.com  
**P** 02 6767 1057

## KEY REFERENCES

Burton KS, Rama T [2001] Bruising: a marked effect. *The Mushroom Journal* 617:20-22 | Burton KS [2002] Bruising means lost mushroom sales. *Mushroom Journal* 624:23-24 | Burton KS [2002a] Mushroom quality: use of bruiseometer to determine which agronomic and environmental factors affect bruisability. II. Effects of humidity, water potential of casing and casing type. Final Report of Project M40a, Horticultural Development Council | Burton KS, Molloy S, Willoughby N [2003] Water is the key to bruising. *The Mushroom Journal* 641:26-28 | Burton KS [2004] Cultural factors affecting mushroom quality – cause and control of bruising. *Mushroom Science* 16:397-402 | Burton KS [2013] Improvements to mushroom quality by reducing bruising damage. *AMGA Journal Winter*:16-18 | Eastwood D, Burton K [2002] Mushrooms – a matter of choice and spoiling oneself. *Microbiology Today* 29:18-19 | Gao W, Weijn A, Baars JJP, Mes JJ, Visser RGF, Sonnenberg ASM [2015] Quantitative trait locus mapping for bruising sensitivity and cap color of *Agaricus bisporus* [button mushrooms]. *Fungal Genetics and Biology* 77:69-81 | Gill WM [2019] Why do mushrooms turn brown? *Australian Mushrooms Journal* 1:24-25 | Rama T, Burton KS, Vincent JFV [1997] Review on mechanical properties and morphology related to mushroom quality. *Plant Biomechanics* 1997:295-300 | Weijn A, Tomassen MMM, Bastiaan-Net S, Wigham MLI, Boer EPJ, Hendrix EAHJ, Baars JJP, Sonnenberg ASM, Wichers HJ, Mes JJ [2012] A new method to apply and quantify bruising sensitivity of button mushrooms. *LWT – Food Science and Technology* 47:308-314 | Weijn A [2013] Unravelling the bruising – discoloration of *Agaricus bisporus*, the button mushroom. PhD Thesis, Wageningen University, Wageningen, NL. pp262

## MU16003 - Pest and Disease Management and Research Services



**tia**  
TASMANIAN  
INSTITUTE OF  
AGRICULTURE

**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](http://horticulture.com.au)

# AGORA WEBSITE HAS NOW MOVED

If you experience any difficulties in visiting the site, or if you are unsure of your login details, please contact Chris Rowley ([chris.rowley@optusnet.com.au](mailto:chris.rowley@optusnet.com.au)) or Judy Allan ([judyallan@bigpond.com](mailto:judyallan@bigpond.com)).

<https://agora.australianmushrooms.com.au>

# AMGA MASTERCLASS DELIVERS A LEARNING EXPERIENCE

The AMGA Masterclass series – Bridging the Compost and Growing Divide – has come and gone, and there are 69 participants who are all the better for the experience.

Held in October in Windsor, Tullamarine, Adelaide and Caboolture, the two-day workshops were very well received, with participants providing very positive feedback about the experience.

The decision by AMGA to underwrite the Masterclass, and to hold the events in different states, provided a fantastic opportunity for farms to send staff to participate and learn, not only from the presenters but also from the valuable interactions with other attendees.

In previous years Australian growers and farm staff wanting to learn more have travelled overseas or taken the opportunity to attend a limited number of courses held in Australia and featuring international presenters. The uniqueness of this Masterclass was that it featured homegrown talent, with the three presenters – Judy Allan, Mike Hill and Dr Geoff Martin - having combined industry experience of 112 years. Importantly this experience is highly practical and hands-on, with in-depth knowledge covering composting, mushroom growing and pest and disease with a clear focus on Australian farms and conditions.

Interestingly the spread of dates and venues allowed some farms to send staff members to different events, instead of 'losing' several staff to the one event. The great thing was that those people who attended comprised a broad cross-section of staff, with some farms sending senior farm managers and others sending less experienced staff with minimal knowledge. The common denominator was, however, the willingness to learn and to actively participate and engage with others on the course.

## COURSE OVERVIEW

The objective of the Masterclass was to provide participants with an insight into the fundamentals of composting and growing, bridging the divide between the

two in a way that highlighted opportunities to attend to the issues and problems facing the sustainable production of quality mushrooms.

The topics covered included:

- Overview of the Australian Mushroom Industry.
- Picking Techniques to Maximise Quality.
- Post Harvesting Handling Issues.
- The Perfect Spawn Run.
- Casing - A Soil Science Perspective.
- Casing Management.
- The Perfect Pin-set.
- Maximising Yield and Quality - Environmental factors.
- Understanding Phase 1 Composting - Organisms and Enzymes.
- The Seven Pillars of Composting Wisdom.
- Phase 2 - The Inside Perspective.
- Integrated Pest Management and Disease Prevention.

Given the different experience among attendees, the approach adopted by the presenters was one of starting with the basic building blocks of a particular topic and then moving to cover the aspect in more depth. The experience of the presenters and their knowledge of the setup of individual farms allowed them to provide practical examples of how things are done, and how things should be done to improve productivity.

The approach adopted allowed the content to be put forward and distilled in a way that promoted plenty of discussion among participants and allowed the presenters the opportunity to address in further depth those identified areas of additional interest.

The focus on discussion, combined with farm visits at each event, delivered a great mix of theory and practical learning. A special thanks to those industry members who provided access to their facilities as part of this process – Premier Mushrooms, Parwan Mushrooms, P&L Rogers and SJW Mushrooms.

## KEY LEARNINGS

While each participant took away learnings pertinent to their work and farming operations, there were some clear overarching messages delivered across the four groups. Some of the repeated messages from participants included that growing mushrooms is all about consistency and attention to detail through all stages in the process, something aided by what was called MBWA – 'management by walking around.'

## FEEDBACK

The feedback gathered from participants was very positive with an 8.5 [out of 10] overall average rating for the course, and an 8.75 for relevancy of the topics covered over the two days.

The most liked aspects of the course included the farm visits, group discussion and the strong interaction among the participants. The experience of the presenters was also well recognised, with participants appreciating the depth of knowledge and the ability to discuss both as a group and individually with the speakers and other attendees.

The use of videos to highlight aspects of the course was well-received, with feedback suggesting more videos could be used to show on-farm examples of the subjects discussed.

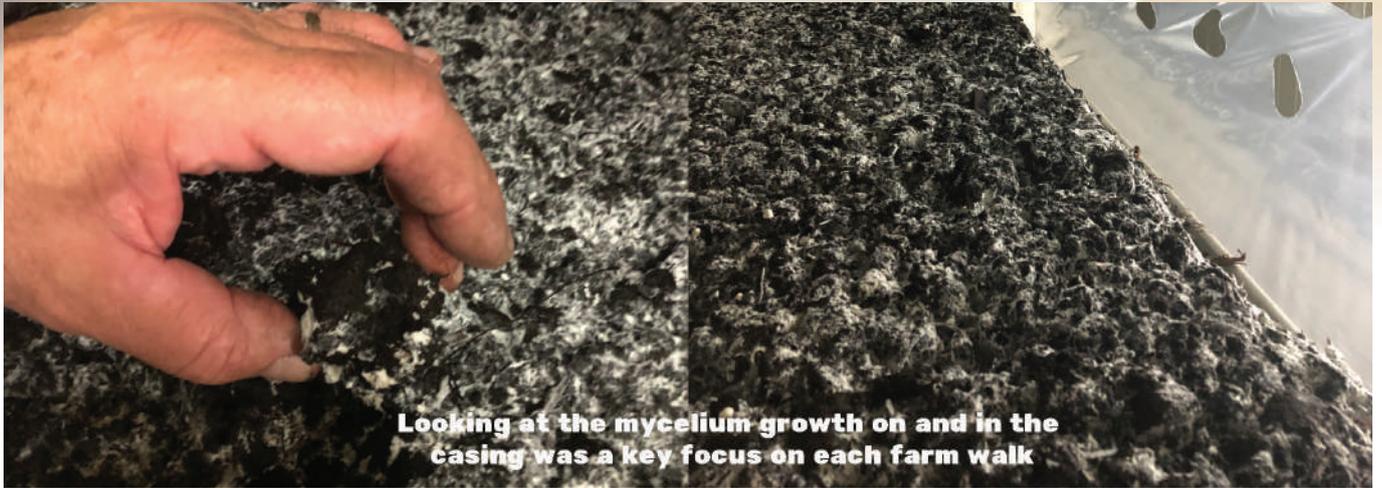
## MORE MASTERCLASSES

With the 2019 Masterclass successfully concluded, the AMGA will now look at the feedback and start to consider the next phase of development of the event. Based on the responses, there is a need for regular activities that build knowledge and are tailored to meet the needs of Australian mushroom producers. As information becomes available on future AMGA Masterclass events, it will be covered in the *Australian Mushrooms Journal* and the monthly *Industry Update* e-newsletter.

Some of the information covered can be seen in the following pages with articles submitted by the presenters.

# Windson

**PREMIER MUSHROOMS PTY LTD**

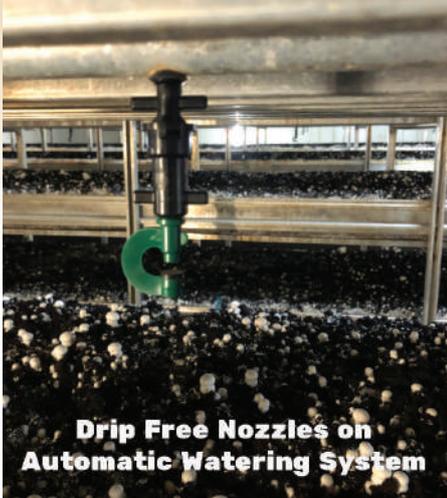


Looking at the mycelium growth on and in the casing was a key focus on each farm walk



# Melbourne

## PARWAN VALLEY MUSHROOMS



**Drip Free Nozzles on Automatic Watering System**

**GOOD HOUSEKEEPING**

- CLEANLINESS
- ORDER
- A PLACE FOR EVERYTHING

**ARE THE KEYS TO SAFETY**

<b>SMALL MEDIUM</b>	35-45 MM	THE NUMBER OF MUSHROOMS IN ONE BOX (APPROXIMATELY)	240-250
<b>LARGE MEDIUM</b>	45-55 MM	THE NUMBER OF MUSHROOMS IN ONE BOX (APPROXIMATELY)	125-130
<b>LARGE</b>	60-70 MM	THE NUMBER OF MUSHROOMS IN ONE BOX (4KG) (APPROXIMATELY)	52-55

**Cobweb**

**Dry Bubble**



# Adelaide

**P&L ROGERS PTY LTD**



# Brisbane

**SJW MUSHROOMS PTY LTD**



# THE SEVEN PILLARS OF COMPOSTING WISDOM

*Geoff Martin*

*Dr Mush Advisory*

The biggest challenge facing compost makers is to be able to make a consistent high yielding compost, week in and week out, from constantly changing raw materials.

This is a synopsis of a paper which I felt might help compost makers meet the challenge. The paper was first presented at a Composting Workshop at the 11th Chinese Mushroom Days held in Zhengzhou China in 2017 and subsequently at the four AMGA sponsored Training Courses, 'Bridging the Compost Growing Divide' held throughout Australia in October of this year.

The Title is somewhat 'Tongue in Cheek' and has its origin from the Book of Proverbs in the Bible, 'Wisdom has built her house, she has hewn out its Seven Pillars.' This lent itself as a simple allegory, whereby what I consider to be the seven most

important factors in composting could be regarded as pillars which in combination support the roof, a high yielding compost, with the pillars in turn being supported by a foundation based on 'Attention to Detail'.

## PILLAR 1: KNOWLEDGE

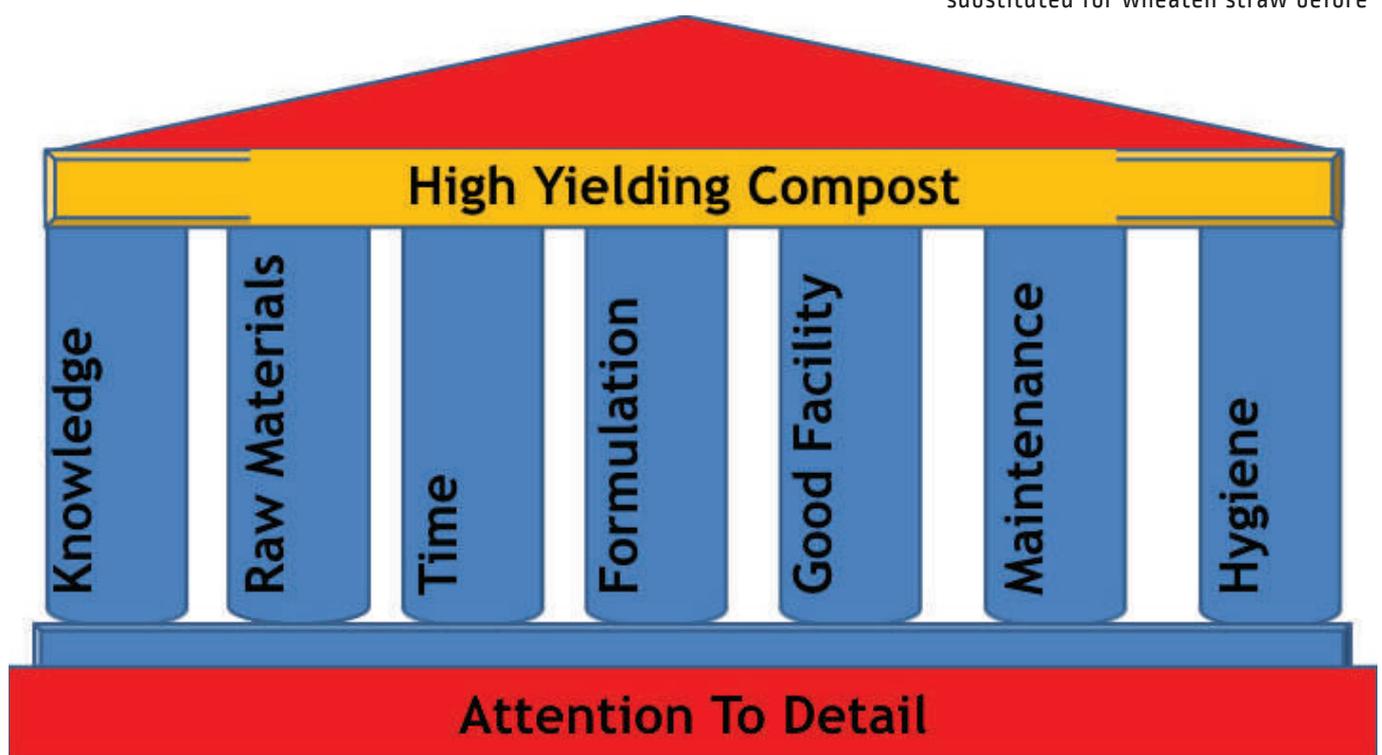
Knowledge is Power! There is a Chinese proverb which says, 'To Know the Road Ahead Ask Those Coming Back.' So to gain a real understanding of the composting process having a good mentor is the first step. It is vital to read the literature, to gain a historical insight into composting; how pioneers and researchers in the 1930s, 40s and 50s helped build the modern composting foundations, followed by researchers and compost makers in the 1970s and 80s who were forced to address environmental issues which lead to the indoor bunkered composting facilities, which we are all familiar with today. It never ceases to amaze me that many of the younger, and not so young, people in our industry have never even heard of Dr Sinden, who was one of the greatest pioneers of the modern

mushroom industry; nor others, such as Stoller, Lambert, Gerrits and Franciscutti who also had a major influence on the techniques we use to make compost today.

As well as reading around the subject, compost makers shouldn't be afraid to experiment; the best and hardest won experience is often gained from making mistakes. Ask questions, visit other operations and talk to other compost makers in the industry. If all else fails you can always call in a composting expert, but be sure to engage one who has real composting experience, not just a run of the mill 'armchair composting expert!'

## PILLAR 2: QUALITY RAW MATERIALS

Quality raw materials are essential if you are to make 'top-notch' compost. You should procure the best raw materials that money can buy. Wheaten straw is the preferred carbohydrate source, but it is as well to know what other alternative carbohydrate sources you can use and at what proportion they can be substituted for wheaten straw before





they start to have a detrimental effect on the structure and quality of your compost. There are a range of alternatives available, sorghum and maize stova, rice, barley, oat and rye straw, sugar cane bagasse and trash, frosted and hayed off wheat, even hay, just to name a few. Learn how to deal with alternatives now, as the day will come when to procure sufficient wheaten straw for your operation may become problematic due to drought, climate change and competition from other users.

Maintain good relationships with your suppliers, let them know what your requirements are, don't accept sub-standard material. Given the increasing cost of raw materials, especially wheaten straw, ensure that the material is being stored in a manner which avoids spoilage by rainfall and loss by fire. Poultry manure is the cheapest source of nitrogen; advances in poultry feed formulation over the last two decades have seen the composting value of this material decline. It is essential to monitor moisture, nitrogen and ash content of this ingredient; blending of different batches of poultry manure leads to a more homogenous compost.

In conclusion, sub-standard starting raw materials will lead to sub-standard finished compost; top quality starting raw materials will give you a better chance at making a good compost.

### PILLAR 3: COMPOSTING TIME

Remember that composting is essentially a micro-biological process, driven by sequences of micro-organisms, bacteria and fungi, which exude enzymes into the compost.

Enzymes are organic catalysts which break down complex organic molecules such as straw cellulose and hemi-cellulose to simple glucose molecules which provide energy. Other enzymes breakdown uric acid and proteins found in poultry manure along sequences of complex metabolic pathways, whereby ammonia is released and then rebuilt into new proteins by the next succession of organisms. Composting is a micro-biological power house, but it is essential for the compost maker to understand that the myriad of unpaid micro-biological workers helping to make the compost, operate within a definitive temperature range between 25 and 65° C and require sufficient moisture and time. Mesophilic organisms which operate at the lower end of the range are particularly important in breaking down straw and releasing ammonia in the compost, which in turn assists in straw softening.

Good composting requires quality



time; essential micro-biological processes require time, nature cannot be rushed. Today, the majority of compost makers' experience has been confined to rapid under-aerated bunkered composting systems and they have little or no experience of making compost employing the longer composting schedules of the past. As is the norm, 'There is nothing new under the Sun,' with the first under-aerated bunker composting system being developed in Paris by Sarazin in 1948! However it was only from the 1990s that composting operations worldwide adopted under aerated bunker systems. Whilst under aerated compost has allowed compost makers to reduce composting time, from my perspective it is a two-edged sword.

Making a selective compost from the type of hard wheaten straw grown in Australia in as short a time as 12 days is problematic as there is a real danger that the low temperature mesophilic range is neglected completely. Once material is subject to under aeration, compost temperatures rise rapidly beyond the mesophilic and indeed thermophilic organisms' optimum operating ranges. Incomplete composting of carbohydrates results in high temperatures at the start of Phase 3 and leaves compost wide-open to infestation by aggressive *Trichoderma* species. By careful nurturing of mesophilic organisms these problems can be avoided; neglect the mesophiles at your peril. Give your compost time in the mesophilic range.



*Under Aerated Composting, Andre Sarizin, Paris, 1948*

#### **PILLAR 4: CORRECT FORMULATION**

As a compost maker you must understand the importance of the C:N ratio. Optimum and rapid composting occurs when there is sufficient moisture and the combination of starting ingredients has a C:N ratio of between 30:1 and 20:1; with 25:1 being the optimum to aim for. Outside of this range composting can and does occur, but not as efficiently. You should be aware that your carbohydrate source is not exclusively carbon and that straw also has a nitrogen component; conversely poultry manure and other organic nitrogen sources also contain carbohydrates. However, formulation is not an exact science, analysis is done on only a small sample of the compost and a fraction of this is used for testing. It is not appropriate to keep altering weekly formulations based on sample analysis; the smart compost maker watches trends in the compost and adjusts the formulation infrequently, but is mindful when new season straw appears on the horizon or there are major changes in the quality of poultry manure. 'Death by Analysis' and overthinking are major failings on many composting operations, these can negatively impact compost quality; best to adopt the adage 'Keep it Simple!'

You should be mindful of your schedule and make it as repeatable as possible, such that every week the tasks are the same and that your

labour force knows exactly what they are to do on any particular day. In particular, you should pay attention to the quality of your recycled water used for wetting bales. 'Goodie water' should be kept well aerated and screened as it is an important source of micro-biological organisms for your composting process. Do not be frightened of water, it is essential for the composting process; too many composting operations seem to run material on the drier side; trying to add water progressively is not the smart thing to do. Blending and mixing are an important function of the composting process; homogeneity is all important for a high yielding compost.

#### **PILLAR 5: GOOD FACILITIES**

There are several issues to be borne in mind when choosing the site for a green field composting operation. The main ones being proximity to raw materials, straw and poultry manure. If you are selling compost, proximity to your potential customers, or to your own mushroom operation is a consideration. Access to a reliable water supply and mains power is essential. Can you source labour locally? More important, how close are your neighbours to your potential location and will odour and other environmental factors be a concern?

Once you have determined the

site for your facility, or if you are upgrading an existing operation, remember this: 'Engineers can plan and construct anything you want, but you must know how you want to make your compost and the schedule you want to follow; then you can give them the necessary information as to the conditions you require.' Remember that engineers are not compost makers and a solution that might work in one location may not be appropriate for the type of locally available raw materials and your conditions. Unfortunately, when it comes to the design of new, or upgrades to, composting facilities, this seems to be increasingly left to engineers and accountants rather than the compost makers ultimately tasked with running the completed operation.

#### **PILLAR 6: MAINTENANCE**

Poor maintenance will compromise your compost. Constant breakdowns and machines that don't start easily on a cold winter morning, or any morning for that matter, interrupt production and frustrate staff. Maintenance staff should be treated as a service provider to the production department, not the converse. The composting environment is extremely harsh, equipment will last much longer if it is washed down daily after use and is serviced properly. You should continually strive for



constant improvement on your operation and fix things properly when they breakdown; there is no room for a quick fix mentality on a composting operation. Have maintenance schedules and ensure they are adhered to; plan for rebuilds and replacement of equipment before and not after you have a catastrophic failure.

On your operation, you need to pay particular attention to fans, aeration lines, drainage sumps, pumps and air filters. In addition, temperature probes, especially those used in Phase 2 and 3 tunnels, should be checked frequently and re-calibrated as necessary. You should keep in stock; belts, bearings, hydraulic hoses, spare motors, frequency drives, electrical contactors, computer modules and anything else you can think of that can adversely affect production should it fail. Invariably, equipment will always fail on weekends or public holidays, when it is impossible to obtain parts quickly; having a selection of essential spares allows your operation to operate smoothly and avoids compromising your compost.

### **PILLAR 7: HYGIENE**

Whilst hygiene is paramount in indoor Phase 2 and 3 facilities, it is also important on the Phase 1 compost yard too. Phase 1 machinery, loaders and equipment should be hosed down daily after use. Phase 1 Bunkers

must be washed out after emptying, making sure nozzles are not blocked and that you have a schedule for the cleaning of under aeration pipes and traps. As for Phase 2 and 3 facilities, all filling and emptying equipment must be cleaned and disinfected after and before use, particular care must be taken where emptying of Phase 3 and spawning of Phase 2 occurs in the same hall. If a tunnel which has contained Phase 3 compost is not to be refilled with green compost then it should be steamed out. Tunnel nets should receive particular attention, cleaned and washed after each pull; this will extend their life and prevent disease. Ensure that spawn and supplement hoppers are emptied of material and cleaned down after use. It goes without saying that concrete areas must be adequately hosed down with clean water.

### **THE FOUNDATION: ATTENTION TO DETAIL**

Of course our seven composting pillars are built upon a solid foundation, 'Attention to Detail,' is the most important aspect of composting. As a compost maker you must be a keen observer, you must use your eyes. You must also use your other senses, touch being the most vital, hone your squeeze test for checking compost moisture and instruct your staff in this vital aspect too. You must use smell, hearing and even taste on occasion! You should keep records and make notes, you should especially

follow trends and see what works best.

You don't need a MBA to manage a composting operation, but you really do need to have your MBWA, that's shorthand for 'Management by Walking Around'. You cannot manage a composting operation from your office; it is essential that you spend as much time as possible walking around your operation, watching and observing, checking your compost, making sure that your staff are doing the right thing, developing your sixth sense and your ability to problem solve and fix things before they become a major headache. And finally, the most important thing of all 'Remember what you walk past is the standard you set!'

### **FURTHER INFORMATION:**

*Geoff Martin*

**E** [drmush@iinet.net.au](mailto:drmush@iinet.net.au)

**M** 0415 542 301



# VACUUM COOLERS

*The most effective way to extend the shelf life of your mushrooms*

Cooling your fresh mushrooms with a KOLDTEK engineered vacuum cooler will **maintain mushroom quality extending the shelf life!**

*Koldtek vacuum coolers tick all the boxes:*

- ✓ **Fast cooling** - 15 to 20 minutes cooling time.
- ✓ **Reliability** - low maintenance and low running costs.
- ✓ **Australian designed** - stainless steel construction, state-of-the-art componentry. Our vacuum coolers are designed to your particular requirements.
- ✓ **Rent or Buy** - Short or long term agreements available as alternative to purchase.



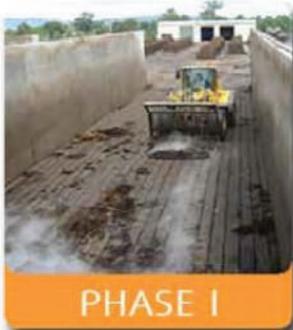
Vacuum Coolers for Lease or Purchase  
Call us now, on: (07) 5549 0234

**KOLDTEK**<sup>AUSTRALIA</sup> [www.koldtek.com.au](http://www.koldtek.com.au)



Worldwide innovation  
since 1973

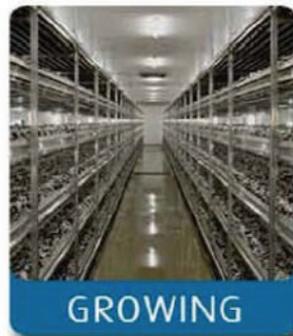
Your partner in Turnkey Projects, Project Engineering,  
Airhandling Equipment and Computer Controls



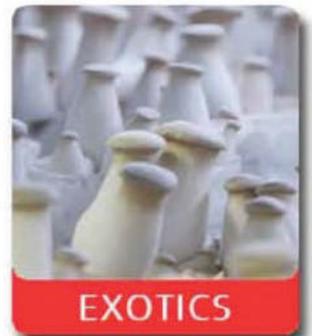
PHASE I



PHASE II/III



GROWING



EXOTICS

visit our website @ [www.aembv.com](http://www.aembv.com)



# DES-O-GERM™ SP

Your **complete sanitiser** for mushroom farming.

**A BROAD SPECTRUM BACTERICIDE, FUNGICIDE, VIRUCIDE AND ALGAEICIDE**

Totally environmentally friendly, non-toxic to humans and animals, biodegradable, non-corrosive, manufactured to HACCP & ISO 14000 standards.

## **DES-O-GERM™ SP can be used for:**

- ✓ General sanitation.
- ✓ Air conditioning units.
- ✓ Foot baths.
- ✓ Spraying down of walls, floors & machinery.
- ✓ Washing of hands, crates, picking equipment.



**Sylvan**  
CULTIVATING EXCELLENCE

SYLVAN AUSTRALIA PTY LTD

t: 02 4572 0555 | f: 02 4572 0055 | [www.sylvaninc.com](http://www.sylvaninc.com)

# GROWING CONSISTENCY IS IT “SINE” LANGUAGE?

*Mike Hill*

*Mushroom Consultant*

The complexities of nature never cease to amaze me, and with the Attenborough's of this world its wonders have been brought right into our living rooms for us to admire and learn. How bees collectively as a colony for instance, with one-mindedness work together to produce the honeycomb and its perfect hexagonal cellular structure.

The Good Book from times of old has taught us in Proverbs 6:6 to 'Go to the Ant, thou sluggard consider her ways and be wise'. Wisdom??

In the world of fungi, we have a perfect example here of a symbiotic relationship between one species, a termite ant, with another an edible mushroom. The mushroom relies on the termite to make its substrate, and retain its spores for inoculating at the right time. Nurturing the vegetative mycelium until there is a change in the weather or a trigger whereby the mushroom grows into its giant fruiting body. The spores are once again collected by the termite colony for safekeeping and the now



supporting fungal structure feeds the whole colony with a well-deserved delicacy. The nearby village is also blessed with this post-rain harvest. How wonderful!!

We can learn from the ant, and although not programmed as such we have had great teachers in the industry who have studied this biological process of growing *Agaricus*. What is knowledge though if we do not have wisdom and apply this knowledge correctly and build on what we gain?

Composting is a process where we select our raw materials that at best are inconsistent and with knowledge and skill, the compost maker turns

inconsistency into consistency. It's a biological process that needs time. It's a process governed by the laws of that process where microflora operate in their own 'space'. For the right composting process to take place, the environment has to be manipulated with water and air to encourage the correct mesophilic flora to multiply, generate heat and to initially soften the straw. Enzymes are released by these vital micro-flora and in tandem they breakdown the structures of the straw which are building blocks to further complex biological pathways that lead eventually to the finished product.

This is a world of its own. Species that aid each other to survive and others that produce toxins and antibiotics to eliminate their competitors. The skilled compost maker and mushroom grower takes this inconsistent biological product and manipulates and changes it into the consistent selective substrate that is ready to be inoculated for commercial production.

The compost maker/grower is often restricted by the composting installation and the tools at his disposal. The selectivity or the consistency of the product he or she makes is dependent on the conditions that are provided and that alone and not the sophistication or the trappings of the installation. It is



often knowledge gained and training that allows the grower to circumvent any shortfalls of the plant equipment or installation that may underdeliver. With experience comes wisdom.

If the Phase 1 and Phase 2 biological process has not been given the required time to complete, it all signals trouble ahead. Without the proper completion of one phase, there is always compromise in the next. Lack of selectivity in portions of the substrate is always the compromise. Whether there is residual NH<sub>3</sub> [ammonia] at the end of Phase 2 or an incomplete mesophilic or thermophilic phase where saccharides are not bound, competitor moulds, for example trichoderma, are always there willing to proliferate.

Without a well completed well finished, Phase 1 and 2 and a troubled inconsistent Phase 3 with the resultant uneven growth from too higher substrate temperatures, the potential of maximising yield with supplementation is compromised. Supplementing troubled spawn runs [Phase 3] further feeds weed mould activity in non-selective areas and can jeopardise further the whole medium. The decision not to supplement will lower yields significantly.

What inconsistency brings, is that the grower has to make compromised decisions that are not routine. In normal circumstances, a grower receives Phase 3 and cases shortly thereafter blanketing the substrate. This firstly traps heat, Co<sub>2</sub> and increases the rate of respiration. In the first two days of re-anastomosis

there is a resultant temperature spike which is controlled and expected. It settles and temperatures continue between 25 - 27c [Optimum Growth Temperature].

In compromised substrates where we have situations where the supplement may not be mixed in properly where dry areas are not correctly conditioned and there are areas of residual NH<sub>3</sub>. The permutations are numerous. When this occurs we immediately find the temperature in the substrate starts to split and range. One scenario for example is where temperatures range from 25 - 35c and continue to rise in a number of different beds as high as 38c. What does the grower do? Do they forget the high temperature beds and only look after the majority midrange beds when 80% of the room is sitting in range, while 20% are in jeopardy and in high range. The farm's profitability is somewhere in that compromised 20%.

In this situation, decisions have to be made!! The grower drops the room air temperature, increases fan capacity and has to as a last resort apply extra watering to the casing. In the areas that are over supplemented, there is 'free heat' and the casing dries where evaporation is at its highest. Casing growth is accelerated in those areas within the casing and especially at the interface. Not with quality thick stranded mycelium but with thin fine stranded 'air mycelium' that are not conducive to transporting cytoplasm. The areas that had low temperatures in the bottom range

now get too much water and become 'waterlogged'. Mycelium growth at the interface and within the casing is now compromised. The casing surface in these areas has 'panned' and has lost its structure. In short, there is now uneven casing and growth throughout the room, all because of an incomplete and unfinished Phase 1, 2 or 3.

The grower now has a dilemma as they now have to aerate the room and induce pinning where surface growth is uneven. This results in areas that are 'locked out' where no pins form, through to areas where pins form very deep under the casing and produce dirty mushrooms.

Throughout my presentation, I have tried to emphasise the importance of eliminating variances and inconsistencies during the growing process. We are however free-thinkers, and with that we suffer distractions, and are easily side-tracked!!!! Teamwork is often tricky, and we have reputations to protect.

How vulnerable is your operation?? Each variance is a compromise away from stability until, collectively, they become a tipping point. Every farms production rises and falls in a 'sine wave' pattern and a line can be drawn to show 'average production' to 'actual production'. The tighter the sine wave and amplitude to budget and higher the more controlled and more successful the operation. The greater the amplitude, with swings and deep 'troughs' where the average is below budget, the more compromised the operation. More times then not a farm like this will have many problems and no fixed cultivation pattern. A farm cannot 'fine-tune' its growing practices if it does not have a consistent substrate week in and week out. Remember your profitability is in that compromise.

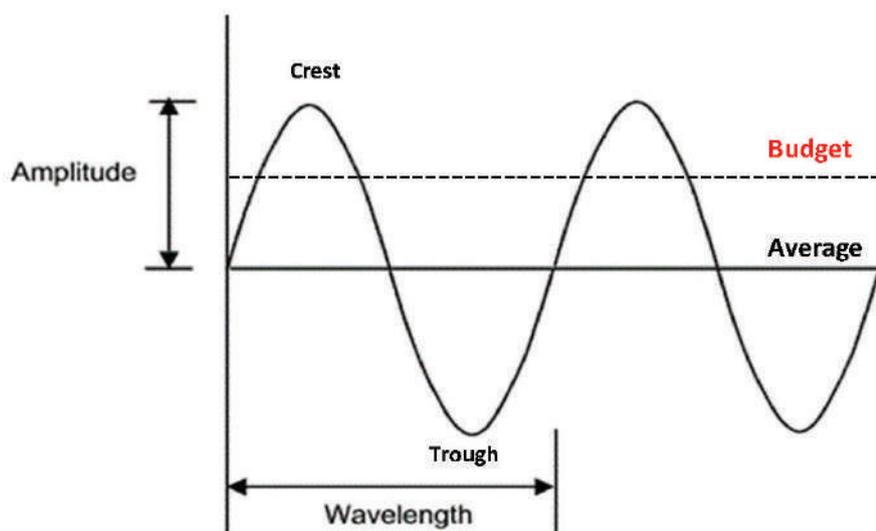
Nature does not compromise. Without the termite, there is no mushroom, and without the bee there is no honey. Without the Queen Bee there is no hive. That's another story.

#### FURTHER INFORMATION:

Mike Hill

E mikehill1407@gmail.com

M 0415 235 208





# GLOBAL AXIS

IMPORT SOLUTIONS

[www.globalaxis.com.au](http://www.globalaxis.com.au)



READY FOR USE CASING



READY FOR USE CASING



SPAWN AND SUPPLEMENT



NICOLON GROWING/CASING/TUNNEL NETS



MUSHROOM GROWING HOUSING AND EQUIPMENT



LIGHTING



COMPOST AND MUSHROOM MACHINERY



**GLOBAL AXIS**  
IMPORT SOLUTIONS

KNIVES AND WATERING EQUIPMENT



**GLOBAL AXIS**  
IMPORT SOLUTIONS

AG CHEMICALS

Phone: (08) 8277 1040

[admin@globalaxis.com.au](mailto:admin@globalaxis.com.au)



**Mush Comb for all your:**  
Mushroom Equipment  
Composting Machinery  
Mushroom Exotic Projects  
Casing Separators



The Netherlands  
T +31 77 398 39 29

[info@mushroommachinery.com](mailto:info@mushroommachinery.com)

[www.mushroommachinery.com](http://www.mushroommachinery.com)

# THE IMPORTANCE OF UNDERSTANDING AMSAFE

As with any learning experience, it is essential to provide foundational information that allows participants to understand the behind the scenes activities that underpin the long-term development of the industry. As part of the recent Masterclass series, attendees were provided with an overview of the structure that is in place to protect the reputation of the industry.

## WHAT IS AMSAFE?

Over the years, the Australian mushroom industry has developed and operated a process called AMSAFE. The process was put in place as a way of having a structured approach to dealing with any issues that could impact the industry's reputation.

While AMSAFE has continued to evolve and develop to meet the changing needs of the industry, there is now a levy-funded project in place that is responsible for the Australian mushrooms industry reputational risk management plan. The objective of this project is simple: to enhance and protect the Australian Mushrooms brand by ensuring the industry responds to any threat or issue in a planned, coordinated and unified manner.

## WHY IS THIS REPUTATIONAL PLAN IMPORTANT?

The plan provides support for every industry participant. It operates as a risk management framework to identify and mitigate reputational threats to mushroom growers, and to the broader mushroom industry, with an Issues Management Team available, if and when required to respond.

The recent accident on the Newman Venture farm in Queensland provides an excellent example of how AMSAFE operates. By notifying the AMGA and implementing AMSAFE within hours of the accident, the farm was provided with support to deal with the issue

and the subsequent media enquiries.

At an industry level, most farms have had accidents, so it is important to share information on what happened so that other growers can check and evaluate their own processes of farm safety. At a broader level, information is required to reassure the public that the industry takes safety seriously and has procedures in place to mitigate risk and ensure the wellbeing of employees, contractors and farm employees.

When an issue arises, effective communication is imperative to help build trust. Trust is a crucial pillar in protecting the reputation of the industry.

## HOW CAN AMSAFE PROVIDE SUPPORT?

AMSAFE is in place to provide support to address any issue – large or small - that can affect the industry. For example, issues like pesticide detection pose a genuine threat to our industry. If a pesticide was detected and reported widely in media outlets, there is no doubt it would impact the reputation and consumption of mushrooms.

AMSAFE is there to provide support to growers by having a trained Issues Management Team on call, comprising a mix of communication and industry experts. Advising AMSAFE when an issue arises on your farm will start a process whereby AMSAFE will review the issue at hand, gather appropriate information and decide on any action required.

As part of being risk-ready, the team has already worked with industry to identify potential issues in order to develop position papers that detail the industry response. By being prepared the team is able to support the industry, assess the issue and lead a coordinated and timely response.

## WHAT TYPE OF ISSUES ARE COVERED THROUGH THE AMSAFE PROCESS?

Over the past few years, food safety issues have impacted the strawberry and the rockmelon industries. Food safety remains a top priority for mushroom growers. Risk to food safety include physical and microbiological contamination, and also issues like chemical contamination. Other risks include environmental or sustainability issues, product quality, ethical industry behaviour and broader industry issues such as biosecurity, pest and disease outbreak, supply chain disruption or data breaches.

From the AMSAFE viewpoint, everything and anything that could potentially impact the reputation of the industry should be considered an AMSAFE issue. There are plenty of examples where industries have had reputational damage based on a problem that starts with one grower or farm.

Reputational risk is not just about the biggest or smallest farm, it is about the whole industry, and it requires everyone to play their part in managing this risk. Part of this management process is ensuring that everyone knows how to access AMSAFE, and is confident that when reporting issues, they will be handled appropriately and with discretion.

## HOW DO GROWERS OR INDUSTRY PARTICIPANTS CONNECT WITH AMSAFE?

The AMGA is your industry representative body and your point of contact for AMSAFE. The AMGA has extensive experience in managing the AMSAFE process and remains an integral part of the process. If something happens – even if you are unsure of the potential implications – call **AMSAFE on 02 4577 6877**.

Theme	Explanation	Example Issues
<b>Food Safety</b>	<ul style="list-style-type: none"> <li>Any issue (real or perceived) that affects food safety – caused by the industry or others along the supply chain – must be taken seriously, both operationally and from a reputation standpoint.</li> </ul>	<ul style="list-style-type: none"> <li>Microbiological contamination e.g. Listeria.</li> <li>Chemical contamination.</li> <li>Physical contamination e.g. foreign bodies in pre-packed mushrooms.</li> <li>Health impacts e.g. picking wild mushrooms / false claims.</li> </ul>
<b>Environment and sustainability</b>	<ul style="list-style-type: none"> <li>Environmental issues caused by the production and sale of mushrooms.</li> <li>Environmental issue directly related to inputs.</li> <li>While localised environmental damage can be relatively moderate, the broader reputational damage can be considerable.</li> </ul>	<ul style="list-style-type: none"> <li>Environmental contamination e.g. run off to water courses / air pollution.</li> <li>Resource issues –availability of compost/peat, potential residues from broadacre agriculture.</li> <li>Resource issues end-product e.g. packaging.</li> </ul>
<b>Product quality</b>	<ul style="list-style-type: none"> <li>Australian mushrooms are largely unbranded, so poor retail experience reflects across the industry.</li> <li>A coordinated, industry wide position and response is essential.</li> </ul>	<ul style="list-style-type: none"> <li>Product quality.</li> <li>Shelf life.</li> <li>Legal compliance – e.g. weight/labelling.</li> <li>Presentation/packaging fit for purpose.</li> </ul>
<b>Ethical industry behaviour</b>	<ul style="list-style-type: none"> <li>Industry participants must be aware of requirements and accountable for their behaviour.</li> <li>The behaviour of one participant can affect the reputation of an entire industry.</li> </ul>	<ul style="list-style-type: none"> <li>Fair work compliance.</li> <li>Worker health and safety compliance.</li> <li>Immigration regulations.</li> <li>Pricing and ACCC compliance.</li> </ul>
<b>Broader industry issues</b>	<ul style="list-style-type: none"> <li>A range of precompetitive issues that may impact industry reputation if not addressed with a consistent and unified industry approach.</li> </ul>	<ul style="list-style-type: none"> <li>Biosecurity.</li> <li>Pest or disease outbreak.</li> <li>Supply chain disruption.</li> <li>Workforce availability.</li> <li>Resource availability.</li> <li>Climatic impact.</li> <li>Data breach.</li> <li>Product claims e.g. organic certification / standards / consumer expectations.</li> </ul>

# AMSAFE - 02 4577 6877

**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](http://horticulture.com.au)

# How to proceed in a crisis

AMSAFE safeguarding our future!

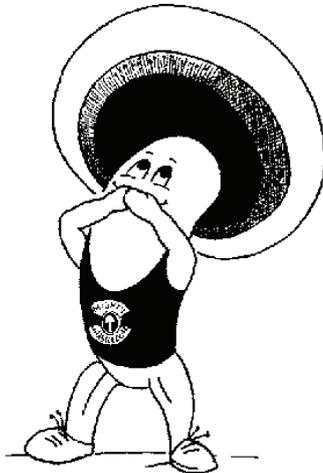
1



**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'

# RECYCLED ORGANICS AS ALTERNATIVE CASING MATERIAL

The Australian mushroom industry uses approximately 25,000 tonnes of peat casing each year. The peat is mostly imported from Europe or Canada, and is a non-renewable and at \$300 per tonne, an expensive resource.

The NSW Government has funded Applied Horticultural Research to undertake a grant project that demonstrates the technical and economic viability of blending locally-sourced composted garden organics with peat, as an alternative to pure peat casing.

This is no easy task, as particular qualities of peat make it ideal for use as casing material. Casing must provide physical support for mushrooms, have a high water

holding capacity, withstand frequent irrigation without disintegrating, be permeable to gases and have a low salt content. Casing should also have low nutritional value and be free of pests and disease.

A variety of materials have previously been investigated internationally, including spent mushroom compost, pine sawdust, paper pulp, composted mushroom stalks, composted vine shoots, composted water weeds, and sugarcane bagasse.

Composted garden organics has proved successful in combination with peat, at rates of up to 12.5%.

Garden organics must produce a similar yield, be available in sufficient quantities and competitively priced,

if it is to be economically competitive with peat as a casing material.

In the coming months, the project will develop a range of peat and composted garden organics casing blends, for testing in pilot crops at the Marsh Lawson Mushroom Research Unit, University of Sydney.

This project is supported by the NSW Government as part of Waste Less, Recycle More, funded from the waste levy.

## FURTHER INFORMATION:

*Adam Godlwater*  
*Applied Horticultural Research*  
E [adam.godlwater@ahr.com.au](mailto:adam.godlwater@ahr.com.au)  
M 0466 080 693



# FOOD SAFETY & QUALITY CERTIFICATION UPDATE

For those businesses certified to Freshcare please read the following information.

If your Freshcare on farm food safety and quality audit takes place in January or February 2020, you will need to be prepared and transitioned to FSQ4.1, as from the new year no audits to FSQ4 will take place.

Commence the transition process now, start by reviewing and updating your Freshcare documents and records to ensure you're adequately prepared.

Information to assist the transition to FSQ4.1 is available here: <https://www.freshcare.com.au/standards/fsq4-1>

If you have any questions regarding the transition to FSQ4.1, contact the Freshcare office at [info@freshcare.com.au](mailto:info@freshcare.com.au) or 1300 853 508.

The transition from FSQ4 to FSQ4.1 is required for all audits from 1 January 2020.

Freshcare Standards that remain current from 1 January 2020 include:

- Freshcare Food Safety and Quality - Edition 4.1 [FSQ4.1].
- Freshcare Food Safety and Quality Supply Chain - Edition 1 [SC1].
- Freshcare Environmental - Edition 3 [ENV3].
- Freshcare Environmental Viticulture - Edition 2 [ENV-VIT2].
- Freshcare Environmental Winery - Edition 2 [ENV-WIN2].

From 1 January 2020 Freshcare Rules Version 4.3 - July 2019 are applicable to all current Freshcare Standards.

## HARPS

Still unsure if your business needs the Harmonised Australian Retailer Produce Scheme (HARPS) in addition to your existing food safety and quality certification?

A decision graphic has been developed to assist suppliers in determining whether their business requires HARPS. The terminology in this graphic replaces the previous references to Direct and Indirect suppliers, and uses a tiering system to define supply chain responsibilities and actions required by suppliers.

The graphic can be seen below and downloaded at the following address: <https://harponline.com.au/wp-content/uploads/2018/09/2018-09-17-HARPS-Decision-Graphic-1.pdf>

Further information on HARPS and FAQs can be found at: <https://harponline.com.au/>

## HARPS Decision Graphic: Is HARPS required for my business?

v2.0 September 2018

HARPS is a retailer-led scheme designed to assist with compliance to food safety, legal and trade legislation for suppliers to the major grocery retailers in Australia

Tier 1	Tier 2	Tier 3	Out of Scope
<p><b>Your business has a Vendor or Supplier Number to a HARPS Participating Retailer*.</b></p>	<p><b>Your business packs or re-packs any of the following:</b></p> <ul style="list-style-type: none"> <li>• Loose product with PLU/DataBar stickers applied as specified by a HARPS Participating Retailer*;</li> <li>• Retail-branded pre-packs;</li> <li>• Retail Returnable Plastic Crates (RPC's);</li> <li>• Proprietary-branded pre-packs;</li> <li>• Loose product in final retail packaging, packed to a retail specification destined for a HARPS Participating Retailer*;</li> </ul> <p><b>OR</b></p> <p><b>Your business is an Approved Supplier</b> to a Tier 1 business, who supplies to a HARPS Participating Retailer* (in final retail packaging);</p> <p><b>OR</b></p> <p><b>Your business provides Support Services<sup>^</sup></b></p>	<p><b>Your business supplies bulk produce</b> (not in final retail packaging) for further packing to a Tier 1 or Tier 2 supplier;</p> <p><b>OR</b></p> <p><b>Your business is a low volume producer</b> supplying a total of 10 pallets or less per calendar year, per site. This is a collective total across all HARPS Participating Retailers*.</p> <p>(NB: Suppliers of retail-branded pre-packs are excluded from this rule as they qualify as a Tier 1 or Tier 2 supplier).</p>	<p><b>Your business processes fresh produce</b> (e.g. value-adding such as bagged salads, fresh cuts, sliced mushrooms/carrots, shelled nuts etc.). Your business requires food safety certification to a scheme as required by your retailer customer.</p> <p><b>OR</b></p> <p><b>Your business is a virtual broker (agent or merchant)</b> that does not qualify as a Tier 1, 2 or 3 supplier (i.e. you do not physically handle the product).</p>
<p><b>Action Required</b></p> <p>Your business may require HARPS approval, this includes certification to an Approved Base Scheme** and the HARPS requirements by 1<sup>st</sup> January 2019. Contact your respective retailer customer(s) for further information.</p> <p>✓ Base Scheme AND ✓ HARPS</p>	<p><b>Action Required</b></p> <p>Your business may require HARPS approval, this includes certification to an Approved Base Scheme** and the HARPS requirements by 1<sup>st</sup> January 2019. Contact your respective retailer customer(s) for further information.</p> <p>✓ Base Scheme AND ✓ HARPS</p>	<p><b>Action Required</b></p> <p>Your business may be required to be certified to an Approved Base Scheme** by 1<sup>st</sup> January 2019.</p> <p>✓ Base Scheme</p>	<p><b>Action Required</b></p> <p>No action required for HARPS.</p> <p>✗ NO ACTION</p>

\* HARPS Participating Retailer(s): ALDI, Coles, Costco, Metcash (IGA), Woolworths

\*\* Approved Base Schemes: BRC, Freshcare, GLOBALG.A.P., SQF

<sup>^</sup> Support Services: Services including ripening, brokerage activities (agent or merchant), storage and cooling (where product handling and traceability are the responsibility of the Support Service supplier).

**HARPS**

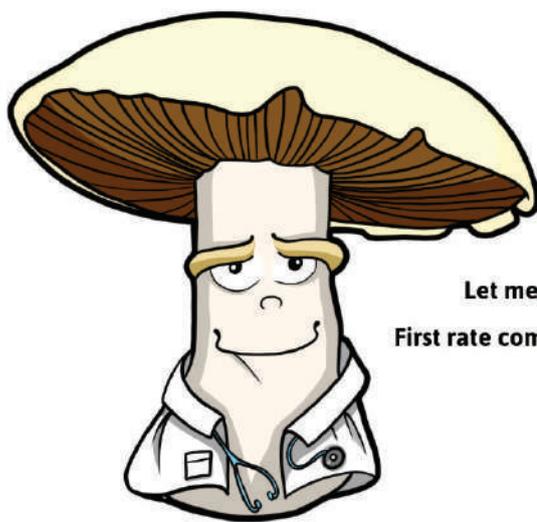
## PASSION FOR QUALITY

### GTL EUROPE

GTL Europe is one of the foremost suppliers of equipment and projects regarding composting operations and mushroom farms. Our product line includes machines, air handling and control systems as well as turn-key facilities. GTL Europe is a capable and reliable partner working with its customers in close cooperation on innovative solutions and developments.



Hudsonweg 2 | 5928 LW Venlo | The Netherlands | T +31 77 396 77 77 | info@gtl-europe.nl | www.gtl-europe.nl



## DR MUSH ADVISORY

Let me help you achieve your farm's true potential!  
First rate composting & growing advice is just a call away.

**Dr Geoff Martin**

☎ 0415 542 301

✉ [drmushadvisory@iinet.net.au](mailto:drmushadvisory@iinet.net.au)

## Mushroom Fly Control

*Biological Control using Entomopathogenic Nematodes (ENs)*

**Targets the larvae to stop the breeding cycle**

- Effective control of larval stage of sciarid fly lifecycle
- Seek out prey
- Safe to use, with no withholding period
- Combat chemical resistance
- Curative and preventative solutions available
- Available all year round with next day delivery



**Ecogrow Environment Pty Ltd**

Ph: (02) 6284 3844

[www.ecogrow.com.au](http://www.ecogrow.com.au)



# FOOD DEFENCE

## Are We Prepared?

While risk factors impacting on supply chain efficiency are considered, supply chains are rarely designed in consideration of the tangible and intangible threats that impact on the integrity of supply itself.

Incidents such as the malicious tampering experienced by the Queensland Strawberry Industry in September 2018 present the stark reality of the need to think outside the box and to expect the unexpected.

No one could have predicted the impact of a single malicious act of food tampering on the very viability of an entire industry sector.

Never before had social media played such a pivotal role in the dissemination of information, initially to fuel the incident and latterly to assist in strategies for recovery.

The lessons learned from the Queensland strawberry incident are many and varied, but the key message

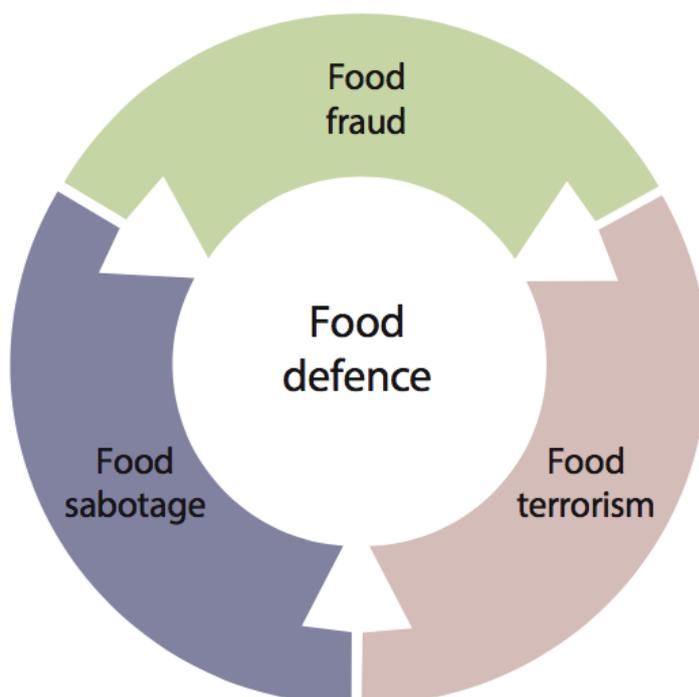
is clear – understand the issue, manage the risks, and be prepared.

'Food Defence' is most effectively used as an overarching term to describe and encompass all the activities carried out to protect food from threats. In simplest terms food defence can be considered to comprise of three distinct elements.

- Food fraud.
- Food sabotage.
- Food terrorism.

Having understood the elements of food defence, we also need to understand the potential perpetrators who might be motivated to carry out those threats.

They can be internal or external to the business, they can be acting in isolation, in groups and even with the knowledge of a business. We also need to understand their possible motivations.



**THREAT** - Deliberate act by someone to cause harm or for financial gain [Something that can cause loss or harm which arises from the ill-intent of people].

**VULNERABILITY** - How exposed the business is to the threat having an impact on the consumer.

**FOOD FRAUD** - The deliberate adulteration or misrepresentation of food, food ingredients or raw materials for financial gain.

**FOOD SABOTAGE** - The deliberate destruction, damage or disruption of food products or processes with the intention of causing reputational damage or financial loss.

**FOOD TERRORISM** - "An act or threat of deliberate contamination of food for human consumption with biological, chemical and physical agents or radio nuclear materials for the purpose of causing injury or death to civilian populations and/or disrupting social, economic or political stability" [WHO. Terrorist Threats to Food: Guidance for Establishing and Strengthening Prevention and Response Systems, Food Safety Issues, Revision May 2008].

### **TYPES OF PERPETRATOR**

- Workers, suppliers, contractors and outsiders, such as extremists or extortionists.

**MOTIVATIONS** - Personal grievances, pressure to achieve, financial gain, ideological, welfare causes - including fair work compliance.

Definitions (above) and image (on left) are © Techni-K Consulting Ltd & Adele Adams Associates Ltd

With an understanding of 'what', 'who' and 'why' we can start to focus on actually identifying different types of threats, and assessing their relevance in our business.

### IDENTIFICATION OF KNOWN AND PLAUSIBLE THREATS

A focus on known threats, either those that have occurred before, so history tells us that they could occur again; or threats that while not having occurred it is plausible to presume they could happen - e.g. foreign objects contamination, chemical contamination accidental and through known misuse.

### IDENTIFICATION OF SUPPLY CHAIN THREATS

The identification of known and plausible threats, and threats from claims require consideration also be given to the entire supply chain to identify where such threats might occur outside the immediate control of the business- e.g. foreign objects contamination.

### IDENTIFICATION OF THREATS FROM AT-RISK CLAIMS

The claims that are made about a product give the consumer an expectation about what they are purchasing, if that claim is not met or is disproven, then there is genuine potential for customer upset.

That response can be attributed to the product and to the company that produced it - e.g. provenance, variety, organic.

If a business can identify and define the threats in a consistent and repeatable way, then they are more likely to achieve an objective result in terms of quantifying and managing those threats.

To do this a business needs to consider:

- How the consumer could be impacted by the threat;

- The actual act and the threat itself; and
- The perpetrator and their motivation.

The impact is considered firstly on the 'asset' we are seeking to protect i.e. the consumer, then on the business - that secondary impact driven by the effect on the consumer.

Once the threat and its impact have been assessed, how susceptible the business is to an individual threat having an impact needs to be assessed, considering both motivation and likelihood of detection.

For a business to be vulnerable to a threat there has to be motivation for the perpetrator to cause harm or damage, and also the opportunity for them to actually carry out the act without detection.

Once threats and vulnerabilities are clearly defined, protection measures should be identified for each potential threat. Protection measures can be either controls or monitoring activities, aiming to prevent, detect or reduce the threat to an acceptable level.

Some very simple steps can take us a long way to gaining control, through both improved infrastructure and systems to monitor employee activity.

**Physical** - packing line CCTV (with clear notices), good site security.

**Systems** - formal team structure and accountability, team meetings, staff monitoring, independent mechanisms to report issues.

Effective systems can and will act to reduce threats and minimise vulnerabilities and, provide a strong foundation for crisis management.

But, like any defence system, it can't and won't be able to control everything, there will always be that 'unknown – unknown' the crisis you didn't see coming.

Effective crisis management strategies for a business, industry or sector need to be in place before that unknown hits.

The mushroom industry is well advanced in this respect, with initiatives like AMSAFE and the crisis management plans coordinated as a levy-funded project managed through Porter Novelli.

This article is based on the work of Adele Adams and Kassy Marsh (ref. *Assessing Threat Vulnerability for Food Defence: 2nd Edition 2018*)



## ASSESSING THREAT VULNERABILITY FOR FOOD DEFENCE

Further information and insight on the topic of Food defence can be found at:

<https://adeleadamsassociates.co.uk/food-defence-vaccp-taccp/what-is-food-defence/>

Including a useful introductory video:

<https://youtu.be/e-iS0eSWGQg>



### FURTHER INFORMATION:

Clare Hamilton-Bate

E [clarehb@bigpond.com](mailto:clarehb@bigpond.com)

M 0407 930 586

**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](http://horticulture.com.au)

# HORT INNOVATION ROUNDUP

## STEERING RAPID GROWTH

Mr Selwyn Snell was re-appointed as Chair, and Dr Mary Corbett retained the Deputy Chair position at the recent Hort Innovation AGM.

Mr Snell said the 2018/19 financial year was the biggest year yet, with Hort Innovation brokering millions in co-investment dollars from a range of partners and sources and securing a significant amount of extra grant funding for investment, through various federal programs.

He said Hort Innovation invested more than \$122 million on behalf of the horticulture sector, including Australian Government contributions, across some 600 projects during the 2018/19 financial year.

Further details on the AGM, including Board appointments is available through the Hort Innovation website.

## MUSHROOM FUND ANNUAL REPORT NOW AVAILABLE

Levy payers and industry participants

can download a copy of the recently released Hort Innovation Mushroom Fund Annual Report.

The report is part of an overall package of reports that include industry-specific investment and project information.

The reports, along with the Hort Innovation 2018/19 Company Annual Report, are available from the Hort Innovation website - [www.horticulture.com.au](http://www.horticulture.com.au).

## IMPACT OF HORT INNOVATION INVESTMENTS REVEALED

During 2018/19, Hort Innovation engaged independent consultants to evaluate the impact of R&D investments. This evaluation examined a random sample of all Hort Innovation R&D projects completed in the 2017/18 financial year, plus a specific look at the impact of work within the Hort Innovation Apple and Pear, Avocado, Mushroom and Table Grape Funds.

The assessments revealed a range of economic, social and environmental impacts being generated for growers, supply chain participants and the community at large.

For the Mushroom Fund assessment, a random sample of five projects was assessed, with their benefit-cost ratio estimated at 2.22 to one, with some \$3.41 million in additional value expected to be delivered to the industry and community over the next 30 years.

A short Fact Sheet describing how the Mushroom Fund assessments were made and what they found is now available[see link below], along with the research providers reports outlining further details and results of the impact assessments for four of the Mushroom Fund projects.

[https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/mt18009\\_mushroom-impact-assessment-work.pdf](https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/mt18009_mushroom-impact-assessment-work.pdf)

## INVESTMENT ANALYSIS

Hort Innovation has developed an interactive chart that allows the industry to see how Mushroom Fund investments are tracking against the industry's Strategic Investment Plan. The chart contains up-to-date information reflecting project investment across the life of the SIP to date, from July 2016 to June 2019. To date \$13.7 million has been invested in research, development and marketing for the mushroom industry during the SIP.

The chart is available on the Mushroom Fund page of the Hort Innovation website - <https://www.horticulture.com.au/growers/mushroom-fund/>

Project Code	Project Name	Present Value of Benefits (\$M)	Present Value of Costs (\$M)	Net Present Value (\$M)	Benefit-Cost Ratio
<b>Strategic Investment Plan Outcome 1: Achieve the bold and ambitious target of domestic consumption of 4 kilograms per person per year of mushrooms by 2021.</b>					
MU09003	International mushroom industry collaboration	0.61	0.21	0.40	2.96
MU12005	Analytics for mushrooms	0.91	0.31	0.61	2.98
MU14000	Communication and education of mushroom nutrition research to health professionals – Phase 2	2.80	1.08	1.72	2.59
<b>Strategic Investment Plan Outcome 2: Mushroom growers are profitable and sustainable through increased yields, reduced costs and effective risk management.</b>					
MU08010	Mushroom industry communication plan	1.37	1.03	0.34	1.33
MU16005	Food safety for the Australian mushroom industry	0.51	0.18	0.34	2.89



### NEW MUSHROOM INDUSTRY STRATEGIC PARTNER APPOINTED

Hort Innovation has announced Mark Spees as the new Mushroom Industry Strategic Partner (previously known as Relationship Manager). The name change to 'Industry Strategic Partner' more accurately describes the function that this role performs, working in partnership with industry.

Industry Strategic Partners like Mark are able to keep you updated with information from your industry's levy investments and how outputs from these can help your business grow.

Contact: Mark Spees - 0439 574 173 - [Mark.Spees@horticulture.com.au](mailto:Mark.Spees@horticulture.com.au)

### STRATEGIC INVESTMENT ADVISORY PANEL

The SIAP met in Sydney from 4-5 December 2019. To provide updates on SIAP activities, a list of meeting summaries is maintained on the Mushroom Fund page of the Hort Innovation website - <https://www.horticulture.com.au/growers/mushroom-fund/fund-management/>

If you have any questions related to the SIAP please contact Hort Innovation Mushroom Industry Strategic Partner, Mark Spees - 0439 574 73 - [Mark.Spees@horticulture.com.au](mailto:Mark.Spees@horticulture.com.au)

### HAVE YOU SAY ON SUSTAINABILITY

Hort Innovation is inviting all people interested in horticulture to share their thoughts on the sustainability of fruit, vegetable, nut, cut flowers, turf and nursery production in Australia.

The short, 10 minute survey will help industry to understand and respond to the issues that are most important to you.

To participate please go to: <https://www.surveymonkey.com/r/HortSustainability>

For more information on this initiative, go to the Hort Innovation website at [www.horticulture.com.au/sustainability](http://www.horticulture.com.au/sustainability) or contact Ingrid Roth, Horticulture Sustainability project lead, on 0428 195 485 or [ingridroth@roth.net.au](mailto:ingridroth@roth.net.au)

### TUNE INTO BRAND NEW GROWING MATTERS

Created just for horticulture growers, the second series of the Growing Matters podcast is here. Promising something for everyone, it's chock-full of practical and interesting info that you can listen to whenever and wherever you want.

The all-new episodes feature Hort Innovation R&D Managers and staff talking with industry experts about hot topics such as using data and insights, accessing information and support on trade, all things pollination, and how to talk to consumers about healthy fats.

You can listen through the Hort Innovation website - <https://www.horticulture.com.au/growers/help-your-business-grow/news-media/2019/podcasts/>.

You can also search and listen on Spotify, Apple Podcasts and Stitcher.

## Growing Matters podcasts

A new podcast series just for growers. All-new episodes are out now

Listen now

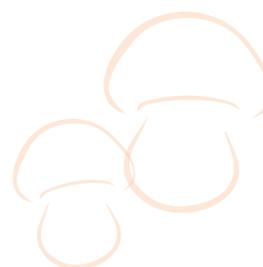
<https://www.horticulture.com.au/growers/help-your-business-grow/news-media/2019/podcasts/>

### FINAL REPORTS

Final reports for Hort Innovation projects are available from the Hort Innovation website.

Examples of available reports are listed below. For any queries please contact: [communications@horticulture.com.au](mailto:communications@horticulture.com.au)

- Phenomenom extension project [MT18015]
- Mushroom crisis management review [MU16001]
- Communication and education of mushroom nutrition research to health professionals (phase 2) [MU14000]
- Mushrooms and health global initiative [MU12015]
- Mushroom industry communication plan [MU12014]
- Opportunities for mushrooms in food service [MU12006]
- Analytics for mushrooms [MU12005]
- Mushrooms, vitamin D and cognition – human studies [MU12003]
- Mushroom industry knowledge training project [MU12001]
- Communication and education of mushroom nutrition research to health professionals [MU11002]
- Improving consistency of mushroom compost through control of biotic and abiotic parameters [MU10021]
- Mushroom 2016 National Conference [MU15700]
- Transformational innovation performance analysis [AI13011]



# ON-FARM SAFETY: COMBATTING COMPLACENCY

My name is Brad Hislop from WH&SA Pty Ltd. I am Phil Martin's son in law and between his daughter, Juliette Martin and myself, we will be continuing on with his Work, Health and Safety Articles. It has been just over eight months since we had to say goodbye to Phil Martin, and we have felt it every day, however, we feel that it is a necessity to carry on his legacy, to ensure the health and safety of everyone.

We are now towards the end of the year and complacency has started to set in, after having another dry year and extra financial stresses. We have seen more accidents in the workplace, and the majority of those accidents could have been avoided.

We also know in the mushroom industry that some day to day tasks can be very repetitive, especially picking, and it is quite easy to become complacent.

A google search on the word 'complacency' results in the following definition: A feeling of quiet pleasure or security, often while unaware of some potential danger, defect, or the like; self-satisfaction or smug satisfaction with an existing situation, condition.

We all, at times, unknowingly get complacent in our lives. For example: When was the last time you arrived home from work and couldn't remember anything about your drive home?

Let's be honest, going to the same places, doing the same activities everyday, can get repetitive. We

go through the motions and are sometimes on autopilot.

Complacency can also happen after success or achievement of a milestone. That is why it is sometimes unusual for a sports team to win a major event repeatedly. It almost seems contradictory that success can bring about such contentment, but when you think about it, once we have achieved a goal set, what do we have to focus on, if we don't set another goal?

While complacency can have impact on our lives by preventing us from living up to our potential at times, the greatest impact of complacency takes place at work when it comes to safety.

When doing a work task, we tend to take shortcuts over time. We think nothing will happen to us. We have a false sense of security.

Yet, accidents can happen and they do happen, every day!

So, how do we combat complacency, so workers stay safe?

## 1. CHALLENGE THE ROUTINE

Consistently ask why something is being done a certain way. Ask yourself and your co-workers if there is a better and safer way to complete a task. Don't settle for 'if it's not broken, don't fix it.' Go for optimising how things are done.

## 2. ALLOW TIME TO RECHARGE

All workers, including you, need a break. Giving yourself time to clear your mind, rest your body, participate in other activities and enjoy the individuals around you is critical. You must work against any potential feelings of guilt when you take time to re-charge.

## 3. CHANGE YOUR ROUTINE

Following a routine, day after day, is a big part of what causes complacency. A routine can cause boredom. Model the way when it comes to setting aside a few minutes each day to exercise your brain in a different way. Talk to a colleague about their job, walk a different path from your car to your workplace, or even change the order of activities you do, to get ready for work. By doing a few things differently from time to time and getting rest, we can try and hold complacency in the workplace at bay, especially during the festive season, with all the extra added stresses.

From the family at WH&SA Pty Ltd to yours, we wish you a very happy and safe festive season!

### FURTHER INFORMATION:

Brad Hislop

E info@whsa.co

T 02 4504 9432





**GROWING**

# Christiaens Group

THE POWER OF COMBINED EXPERIENCE

Not all projects are turnkey projects.

You can of course approach the group for smaller jobs as well.

With the advantage that you can still take the expertise of the whole Group.



Witveldweg 104-106-108 • 5961 ND Horst • The Netherlands • tel. +31 (0)77 399 95 00 • info@christiaensgroup.com • www.christiaensgroup.com

## WORK HEALTH & SAFETY AUSTRALIA

Tired of having to deal with different organisations for all your WHS, HR, IR, Environmental, Chemical Courses, Forklift Trainings, Competency Training, Safety Management Plans, Safe Operating Procedures, Unfair Dismissal Claims & Workers Compensation Claims?

### WE CAN HELP!

WH&SA have been servicing the Mushroom Industry for many years, providing products and services to individual farms, as well as magazine articles and advice to the whole Industry!

### DO YOU NEED HELP WITH ANY OF THE FOLLOWING?

- General WHS issues and frustrations?
- Unfair dismissal claims?
- Is getting quality staff a challenge?
- Is getting a "buy in" to your WHS and HR programs a problem with staff?
- Need help with Safe Operating Policies and Procedures?
- Risk Management training?
- Forklift training?
- Environmental Issues?
- Industrial Relations?
- Chemical training/courses?
- Workers Compensation problems?
- Need Drug and Alcohol testing?

Our programs, systems and training are provided by internationally recognised qualified and ASQA accredited trainers.

**OPERATING SINCE 2003 AND NEVER HAD A CLIENT PROSECUTED!**

Call us to set up your obligation free consultation!

Or email us at:

**(02) 4504 9432 INFO@WWSA.CO**

Sydney Office  
2 Forbes Street  
Windsor NSW 2756

*Peace of mind tailored insurance available to cover costs associated with claims against your company and directors.*

# HAZARDOUS SUBSTANCES & NATURAL EMERGENCIES

This article has been reproduced from an earlier article by the late Phil Martin which appeared in the AMGA Journal in Summer 2013. Given the current bushfire situation it is timely reminder to be prepared. The article has been checked and revised by his daughter, Juliette Martin who is a principle of WH&SA.

## WHAT ARE HAZARDOUS SUBSTANCES?

Hazardous substances are those that when a worker is exposed, can have an adverse effect on health. Examples of hazardous substances include poisons, substances that cause burns, skin and eye irritation, and substances that may cause cancer. Many hazardous substances are also classed as dangerous goods.

## WHAT ARE DANGEROUS GOODS?

Dangerous goods are substances, mixtures or articles that, due to their physical, chemical (physicochemical) or acute toxicity properties, present an immediate hazard to people, property or the environment. Types of substances classed as dangerous goods include explosives, flammable liquids and gases, corrosives, chemically reactive or acutely (highly) toxic substances.

## WHAT CAN I DO TO ASSIST THE FIRE SERVICE IN THE EVENT OF A FIRE?

Have all your hazardous substances in designated and well signposted storage areas.

It is important managers understand that most substances are individually quite safe, however, when several are mixed either by spill or other occurrence like fire, earthquake or tempest, another chemical can be formed, and this new substance can be lethal!

Install an outside 'box' that stores a copy of the Hazardous Substances Register detailing what chemicals you have, how much you have, and the classification. Ensure the 'box' is accessible by firefighters and clearly identifiable with signage.

Remember, the first thing a fire fighter wants to know is, 'What else is burning here?' and 'What extra safety precautions do I need to follow, when dealing with potentially toxic fires?'

## HAZARDOUS MATERIALS FIRE SAFETY

Practicing hazardous materials safety is important in preventing fires.

Many people use chemicals safely every day, but as the number of chemical products increases, the risk for improper use and injury also increases.

## WHAT ARE HAZARDOUS MATERIALS?

When most of us think of 'hazardous materials,' we picture trucks full of chemicals, factories, or dumps oozing slime.

However, every farm can be a warehouse of hazardous materials,

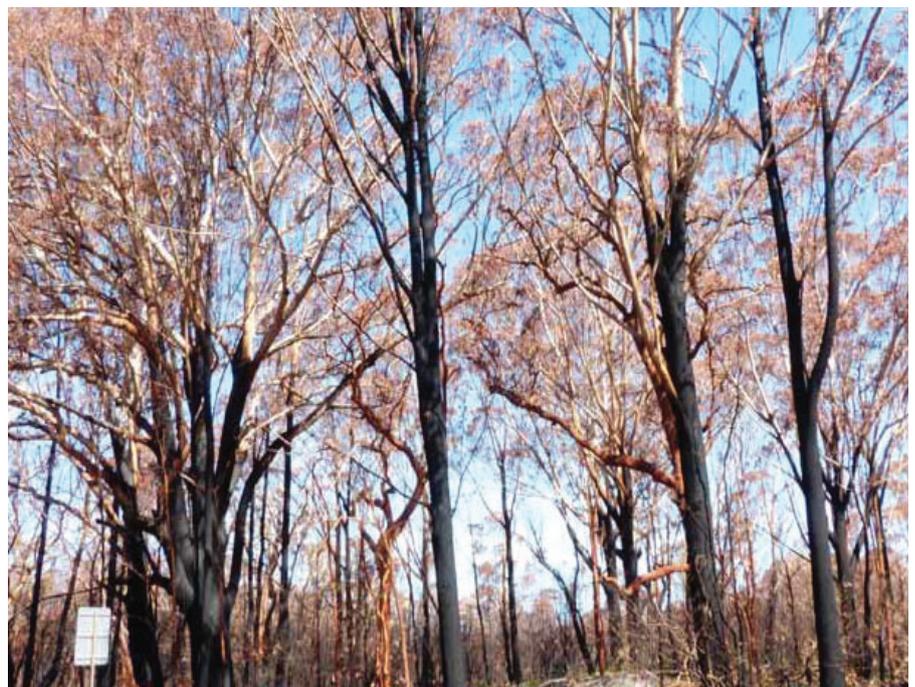
containing items such as:

- Automotive fluids.
- Barbecue products (Fuels).
- Batteries.
- Health and beauty products.
- Maintenance products (Lubricants).
- Household cleaners.
- Laundry products.
- Lawn and garden chemicals.
- Medicines and medical supplies.
- Paints and thinners.

In addition, asbestos or lead paint present in older buildings, and mercury in compact fluorescent light bulbs (CFLs), may become exposed during or after a fire.

## HOW CAN I MAKE MY FARM SAFER?

Farm hazardous materials can pose serious fire, health, or environmental hazards. For these reasons, proper use, storage and disposal of hazardous materials on the farm is extremely important.



## USE AND STORAGE TIPS

- Buy only the amount of product that you need to reduce the quantity of hazardous materials in storage.
- Familiarise yourself with each product, its location, purpose and instructions for safe use. [Refer to the Safety Data Sheet.]
- Follow use and storage instruction on the products label. Mixing some products can create deadly poisonous fumes or cause fires.
- Ensure all users have read, understand and apply the directions as specified on the [SDS] sheets.
- Store hazardous materials in their original containers. Changing contains is not only dangerous – it is illegal!
- Use only portable storage containers listed by an independent testing laboratory for flammables and combustibles.
- Store flammable products – such as gasoline, kerosene, propane gas, and paint thinner – away from combustibles.
- Only fill portable gasoline containers outdoors in a well-ventilated area. Place the container on the ground to fill.
- Never store flammables in direct sunlight or near an open flame or heat source.

- Inspect storage areas regularly for leaky containers, poor ventilation, and the smell of fumes.
- Store hazardous materials out of the reach of children and pets.
- Use guardrails and safety locks on shelves and cabinets to prevent containers from tipping over or falling out, especially if you live in an earthquake-prone area.
- Wear suitable protective clothing including gloves and eyewear as recommended by the product manufacturer.
- Keep oil, grease, and similar petroleum-based products away from oxygen valves. They can cause a spontaneous explosion.

## DISPOSAL TIPS

- Follow disposal instructions on the products label. [Refer to the Safety Data Sheet.]
- Aerosol cans can sometimes contain flammable or poisonous chemicals. If you dispose of them in the trash, they can be punctured and explode, or start a fire.
- In the event of a spill, thoroughly clean the area and place disposal containers in a well-ventilated area. If you cannot control a spill, or are in doubt about clean-up and disposal, call your local fire department.

- If your community has a designated hazardous waste collection day or collection facility to dispose of hazardous materials, use this service whenever possible.
- Pay special attention to chemical products when moving them from place to place. The same rules apply for proper transportation, as they do for storage.

## TIPS TO AVOID AN EMERGENCY DURING A NATURAL DISASTER

Follow these tips to prevent hazardous materials from posing an added danger during natural disasters:

- Always use a flashlight – not a candle – for emergency lighting.
- Knowing how to shut off the gas outside at the meter can save your life during an emergency. Once you shut off the gas, only the gas company should turn it back on!
- Mount or chain propane cylinders securely to prevent them from dislodging and floating away during a flood.
- Secure fuel tanks to a cement slab to prevent them from tipping over, or floating away during a flood. Elevate tanks to prevent damage to the valves.
- Install flexible gas lines from cylinders or tanks to all gas and fuel appliances on your farm.
- Make sure freestanding sheds, rajas, and small barns where hazardous materials are stored are tied down securely to the ground. Reinforced double entry or garage doors.

# RACE

In case of spills or leaks of hazardous materials at work remain calm and – remember RACE

### RESCUE

Rescue any people in immediate danger [only if it is safe to do so].

### ALARM

Raise the alarm / Ring the Fire Brigade on 000 / Notify your switchboard / Notify the staff member in charge

### CONTAIN

Only if you are trained and it is safe to do so, then: contain the danger area, and attend the emergency e.g. contain spill or leak, isolate gas and electricity, etc.

### EVACUATE

Evacuate staff/visitors to the designated safe assembly area.



## FURTHER INFORMATION:

Juliette Martin  
E [juliette@whsa.co](mailto:juliette@whsa.co)  
M 0417 001 544



# your blend for life

---

Our Topterra brand is internationally known for its excellent casing for the professional mushroom industry. We are proud of our team who operates in our fully automated factories. They stand for a consistent and reliable casing so you can strive for the highest possible quality and yields. To further secure our products we have the RHP quality chain control system monitoring the processes and raw materials. We produce a wide range of casing soils so that we can provide you with the best possible product for your own situation and conditions.

*Hans Berden*

Sales Support Australia  
+61 (0) 3 9555267  
info.aus@legrogroup.com

Sales Support Head Office  
+31 (0)88 1717600  
salessupport.mcs@legrogroup.com



[www.legrogroup.com](http://www.legrogroup.com)



The Australian Mushrooms Journal is produced as part of the Mushroom Industry Communication program [MU18001]. This project 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. Advertising within this publication is maintained by the Australian Mushroom Growers Association under an agreement with Horticulture Innovation Australia. This Association welcomes advertising within the Journal. The booking deadline is 6 weeks prior to the publication date. For further information, please contact AMGA on [02] 4577 6877 or via email at [admin@amga.asn.au](mailto:admin@amga.asn.au)

**Hort  
Innovation**  
Strategic levy investment

**MUSHROOM  
FUND**

