31 January 2017

Plant Imports Team and Animal Imports Team

Ministry for Primary Industries

By email to: plantimports@mpi.govt.nz and animalimports@mpi.govt.nz

To whom it may concern,

Re: Proposed new import health standards: Phase 3 mushroom-growing medium and processed animal manure products

Introduction

1. Beef + Lamb New Zealand (B+LNZ) welcomes the opportunity to provide feedback on the proposals described in the MPI discussion documents and supporting information.

2. B+LNZ is the farmer-owned organisation representing New Zealand's sheep and beef farmers. B+LNZ is funded under the Commodity Levies (Meat) Order 2015 through a levy paid by producers on all cattle and sheep commercially slaughtered in New Zealand.

3. B+LNZ represent around 12,300 commercial farming businesses, creating around 35,000 jobs (wages, salaries and self-employment) in the sheep and beef sector. Around three quarters of pastoral land and just under a third of New Zealand's total land area is used for sheep and beef farming. Sheep and beef exports are New Zealand's second largest goods export earner.

4. The continued profitability of the red meat sector is dependent upon protection from weeds, pests and diseases which may impact forage production, animal health or access of red meat products to premium markets overseas.

Comments on the proposals

5. B+LNZ accepts the assessments presented by MPI that risks associated with weed seeds and animal diseases of concern, including anthrax, would be effectively managed by the measures proposed were they to be correctly implemented by producers of compost.

6. However, B+LNZ is concerned that there may be challenging practical impediments to these measures that are required to be overcome if they are to be effective. We understand these include ensuring sufficient temperature increases throughout the entirety of batches of composted material and cross contamination risks to processed compost from ingredient materials.

7. B+LNZ does not maintain expertise on the processing of compost and places a high degree of trust in MPI scientists to undertake thorough analyses of the risks and management options on behalf of New Zealand's primary industries. We suggest that for expertise on the day to day realities of compost production, domestic manufacturers may provide MPI with information and insights that may not be abundant in peer reviewed and grey literature.

<u>Other issues</u>

8. B+LNZ would like to remind MPI that biological (and other) risks associated with imports extend to industries not directly connected with the commodity in question. For example, B+LNZ has belatedly become aware of the (now closed) consultation process on a new IHS for porcine semen, where associated risks include animal diseases able to affect New Zealand's large pastoral production industries, in addition to the pork industry.

9. Accordingly, B+LNZ believes that when alerting or proactively seeking stakeholder feedback on draft standards, MPI should strive to be as inclusive as possible and sensible.

10. The contact for this submission at B+LNZ is:

Dr Chris Houston
Manager – Technical Policy

s 9(2)(a)

Submission (Amended)

To: Plant Imports Team, Ministry for Primary Industries

PO Box 2526, Wellington 6140

Submission on: Phase 3 Mushroom Growing Medium Guidance Document (MPI.GD PHASE3)

Phase 3 Mushroom Growing Medium Import Health Standard (MPI.IHS.PHASE3)

Date: 8 February 2017

Contact: Colin MacKinnon

Ph: s 9(2)(a)

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Submission to the Ministry for Primary Industries on Phase 3 Mushroom Growing Medium Guidance Document (MPI.GD.Phase3) and Phase 3 Mushroom Growing Medium Import Health Standard (MPI.IHS.Phase3)

1. OUR SUBMISSION

1.1. **Aim:** Because of our deep concern about the NZ biosecurity regulations and their implementation, we:

- **Hew Dalrymple**
- **John Hodge**
- **Colin MacKinnon**
- **David Clake**

are making this submission to the Ministry for Primary Industries (MPI) on the consultation documents: Phase 3 Mushroom Growing Medium Guidance Document (MPI.GD.Phase3) and Phase 3 Mushroom Growing Medium Import Health Standard (MPI.IHS.Phase3).

1.2. **Background:** As per 2.1 (1), mushroom growing medium means a growing medium that is produced using a mixture of horse manure, chicken manure, straw, gypsum and water that is inoculated with mushroom spawn prior to export. It is MPI's intention is to allow this mushroom growing medium to be imported from Europe into New Zealand.

- What benefits would such an import approval bring to NZ?

Nowhere in the documentation has this been clarified.

1.3. **Commercial interest:** The request to import comes from one company, Mercer Mushrooms, a company which has only three shareholders, from two families and employs 70 staff. This would suggest that the application is not a balanced industry-supported application but rather targeted to benefit only a small industry sector. This should be reviewed in the context of the over 2,700 farmers in NZ involved in arable farming, bringing combined gates sales of $1 billion who may be negatively impacted by unforeseen impacts of this imported manure. We are deeply concerned about the risk this importation poses to New Zealand agriculture.

1.4. **Economic gain:** Is this is a cost-cutting, profit-gaining exercise for one grower? It is extremely doubtful that such importation will result in any reduction in the price of mushrooms for the NZ consumer or to provide any economic benefit at all. The only reason we can see is to increase the profits of a single company with minimal shareholding. The NZ mushroom industry has produced and continues to produce safe domestic growing medium for nearly 90 years and grown its exporting capability.

1.5. **Biosecurity impact:** The importance of robust and impenetrable biosecurity measures to the future of New Zealand farming and to New Zealand's future economic well-being cannot be understated. Already, despite 'robust measures', many breaches of biosecurity (e.g., velvet leaf, painted apple moth, varroa mite, fruit fly, kiwifruit pathogens), over the past few years have had devastating, long-term impacts on our producers, with detrimental and costly consequences for our environment and for our ability to export our crops. In Section 5 below we itemise some of these breaches and the enormous costs to our country. These breaches show systemic problems with our biosecurity preparedness.

Any new proposals to import material that may pose a biosecurity risk to New Zealand are viewed with dismay.

1.6. **Availability of local product:** Why does Phase 3 Mushroom Substrate need to be imported into New Zealand when these products exist in New Zealand and pose a negligible biosecurity risk to our primary industries? It is preposterous that it is too difficult for NZ companies to gain new resource consents to produce more composting material to make mushrooms, yet this material can be imported.

1.7. **Impact of previous biosecurity breaches:** MPI does not have a good record of keeping our agriculture / pastoral industry safe. There are multiple reasons for caution. For example, pelletised seed was coming into New Zealand in such quantities that our Import Health Standards did not pick up the contamination of fodder beet seed with velvetleaf. The subsequent incursion response has cost the Government over $2M and will continue to cost farmers dearly financially

Thus, from past experience, we are extremely doubtful that, even if the biosecurity risks associated with the importation of these products are met and are stringently audited, our concerns would be mitigated and that no incursion of an unwanted pest would occur.

1.8. **MPI role:** Is MPI prepared to keep an keen and unblinking eye on changing production technologies and techniques associated with methods of production of Phase 3 Mushroom Substrate? Often advances in technology or other matters are made before relevant Import Health Standards are modified. For example, the importation of pelletised seed has altered as a result of the contamination of pelletised fodder beet seed. The subsequent incursion response cost the Government over $2M and will continue to cost farmers dearly both financially and mentally for many years to come.

1.9 Why then, do we have to fight to stop the importation of mushroom growing medium into NZ?

1.10. A pertinent comment from Richard Prosser, MP:

> *""It may have passed this government's notice but New Zealand doesn't exactly want for high-quality compost," says Spokesperson for Biosecurity Richard Prosser.*
>
> *"We were shocked to find imports of mushroom compost called substrate from Europe, but it gets worse. The National Government is working on a new import health standard, which will allow the importation of mushroom compost containing animal manure.*
>
> *"This is patently absurd and dangerous. There were foot and mouth outbreaks as little as five years ago in Europe. In the meantime, supposedly certified fodder beet seeds, also from Europe, were contaminated with the pest plant velvet leaf spreading it from Auckland to Southland.*
>
> *"Only a few years ago supposedly certified European beef was found to be ho se meat. The upshot being that New Zealand cannot afford the 'she'll be right' approach to biosecurity shown by this government," says Mr Prosser.*

2. GENERAL COMMENTS

2.1. The growing medium is made up of horse manure (90%), manure and gypsum (5%) and wheat straw (5%).

- Why does this medium need to be imported? This material is readily available here. NZ has a large horse population (in NZ s thoroughbred stock alone, a highly regulated industry, there are over 5,000 racehorses and 8,000 broodmares) with a subsequently large manure output.
- We have numerous chicken farms with subsequent manure availability

2.2. As horses are well known to be inefficient digesters, their manure will contain weed and pasture seeds.

- How sure is MPI that subsequent heat treating will destroy these seeds and weeds?

3. PHASE 3 MUSHROOM GROWING MEDIUM IMPORT HEALTH STANDARD

3.1. As the material is to be inoculated with live mushroom spawn, how can this be treated to ensure there are no biosecurity risks without destroying the spawn? Does this mean that the spawn will not be rendered safe?

3.2. The introduction states that 'the detection of regulated pests <u>may</u> result in treatment, reshipment or destruction of the consignment'. May needs to be replaced with <u>will</u> and rather than applying treatment, surely the entire consignment must be reshipped at the importers cost and their licence to import, revoked.

3.3. Again under the introduction it is stated 'breach of post clearance condition <u>may</u> lead to a penalty being imposted. May must be replaced with <u>will</u> and the level of penalty stated.

3.4. As part of the introduction under 'Other Information' it is stated that 'this is not an exhaustive list of compliance requirements and it is the importer's responsibility to be familiar with and comply with all New Zealand laws'. Without doubt, this will lead to confusion around what importers need to comply with and what they should take into consideration (and add another escape route for the exporters). The list must be exhaustive. It is MPI's responsibility to make it very clear what NZ's requirements are. If it is 20 pages long, so be it. NZ's biosecurity position must be taken seriously.

3.5. We agree with Federated Farmers that in the introduction to the Import Health Standard (IHS) a complete list of regulatory requirements be included. From our perspective, MPI must eliminate any confusion around what importers need to comply with and what they should take into consideration. The list must be comprehensive and full. With the devastating velvetleaf contamination in fodder beet seed in 2016, it was unclear what pest list velvetleaf was on and whether action had to be undertaken. This is madness.

3.6. Part 1.4(1) states all phase 3 mushroom growing medium must be free from regulated pests, extraneous materials and must not contain any viable weed seeds. It is now unfortunately very clear that viable weed seeds may either hitchhike on material imported or despite the composting process, remain viable. Samples of the composted material must be taken and a germination test completed on this material. This must be a robust process, scientifically conducted. How does MPI intend to improve its processes to ensure that any imported growing medium is free from regulated pests and other material?

3.7. Part 1.5(1) that the National Plant Protection Organisation (NPPO) of the exporting country provides evidence that the national systems/programmes and standards used for export reassurance are in accordance with ISPM 7 Phytosanitary Certification System.

- How are NPPO's performance and systems going to be monitored? We have put our trust in NPPO previously but as with Velvetleaf, despite an NPPO signing off on export consignments as f ee from contaminants and other regulatory requirements, this was not the case.

3.8. Federated Farmers submits that the wording of Part 1.5(2) should be amended to read "the national programmes and standards are subject to **annual** audit by MPI". We disagree with the time period for the annual audits and believe it should be carried out, at a minimum, six-monthly. We ag ee with Federated Farmers recommendation that this is a thorough and whole systems audit rather than a desktop audit. It is imperative that it is realised that the New Zealand farming industry is reliant on having stringent biosecurity rules which are adhered to and not just seen as a regulatory nuisance.

3.9. Part 1.8(1) contains a mistaken reference to Part 2.6: Post clearance conditions. It should reference Part 2.7 in the IHS which describes post clearance conditions.

3.10. Part 2 describes some of the specific requirements that must be undertaken for the Phase 3 Mushroom Growing Medium can be imported. We concur with Federated Farmers seeking further reassurance that the offshore processes will be undertaken as described and will be fully audited by MPI. We have deep concerns about NPPOs ability to comply with our legislation.

3.11. Why does 2.5 (1) state ‘there are no pests associated with this commodity which require an MPI-Specified Measure’?

- On what basis has this statement been made?
- What is the proof? Please clarify.

3.12. Part 2.7.(2) implies that the Phase 3 Mushroom Growing Medium does not receive biosecurity clearance and therefore must be retained at a Transitional Facility until it becomes spent growing medium and is treated to a steam cookout.

- Does this mean that the Phase 3 Mushroom Growing Medium is grown in a transitional facility and packaged or part of the mushroom factory is a transitional facility? Please clarify

3.13. We also note that there is no description of what happens to the spent growing medium in the IHS nor Guidance Material and any biosecurity risks that may still be associated with this product. The majority of the nutritional value will be removed when the spent mushroom growing medium is treated to a steam cookout, so the most obvious next step is to a landfill or discharged onto land. This carries environmental risk and given growing concerns over the quality of freshwater in New Zealand, we do not believe that discharge onto land is the best option for the spent mushroom growing material. The spreading of spent growing medium should not be allowed onto farmland under any circumstances as this still poses a biosecurity risk.

3.14. Part 3.3. describes the requirements for the Manufacturer’s Certificate. This must also include details of where the ingredients for the Phase 3 Mushroom Growing Medium are sourced from and from whom.

4. PHASE 3 MUSHROOM GROWING MEDIUM GUIDANCE DOCUMENT (MPI.GD.PHASE3)

4.1. Part 4.3(3)(a) must be amended to read “a list of all raw ingredients **and where they were sourced from,** used to produce the phase 3 mushroom growing medium”.

4.2. Part 4.5 (1). Change ‘may’ to ‘will’.

4.3. Part 4.5 (3). Even if a supplier is regular, with no compliance problems in the past, the inspection frequency <u>must not</u> be reduced.

4.4 Part 4.5.(1) should be reworded to say “on arrival inspection of consignments will be undertaken for MPI to verify compliance with the requirements of the IHS”. This amendment would provide additional reassurance to our members that all steps are being undertaken to ensure the biosecurity risk associated with this product is mitigated.

4.5. Part 4.6(3) should be amended to make reference to Part 2.7. of the IHS which is post clearance conditions, rather than Part 2.6. which relates to Phytosanitary Inspection.

5. SOME EXAMPLES OF RECENT BIOSECURITY BREACHES

5.1. Is this information relevant to this submission? Absolutely. We must emphasise the cost to our small country when MPI fails to protect our borders, regardless of the import health standards that have been put in place. Having import health standards, guidance documents and risk assessments are of no value at all when the product to be imported is not only inherently risky and not needed in the first place. The economic (and stress) ramifications are far too serious and require absolute diligence by MPI. Do we need to import this product? Is it necessary? Does it bring economic benefits? Any 'no' means that we should not even consider importing let alone try to work out methods to 'keep it safe'.

5.2. Pea Weevil. The pea weevil has been found in a number of commercial pea growing areas. There is now a 2-year ban on growing peas in the Wairarapa. Peas are a $150M industry nationwide and worth about $15M to the Wairarapa district. NZ was one of the only countries in the world free of this pest and that status secured market premiums and key market access.

5.3. Black Grass Weed. A contaminated seed spill from imports of red fescu seed has put NZ's arable sector in danger. In 2011, arable sales had a value of $868M with a total impact of $2.2 Billion

5.4. Velvet Leaf. This vicious weed which could cripple our agriculture industry, came from imported fodder beet seed (from Europe) and potentially other imported grains. Chicken manure which has been used as fertiliser is also highly suspect. Despite 'rigorous' biosecurity measures MPI failed to prevent this incursion. One plant can drop 5,000 seeds which last 50 years. So far there have been 169 positive identifications of velvet leaf in 11 regions. One grower alone lost a $2.5M seed export contract.

5.5. Varroa Mite. This has put the entire NZ bee population at risk. The cost to the NZ economy of this mite has been estimated at between $400M to $900M over 35 years.

5.6. Kiwifruit. Kiwifruit pathogens are expected to cost the NZ kiwifruit industry approximately $500M to $600M over 10 years and $740M to $885M over 15 years.

5.7. Apple Moth. The cost to the country of this moth has been estimated with a range of %58M to $356M. So ar, $65M has been spent on its eradication.

6. QUESTIONS REGARDING THE IMPORTERS

6.1. Have the importers processed animal manure products justified their need to bring this material into New Zealand?

- What is their business case? Has one been submitted? Does it justify importing this material rather than using NZ products?
- What is their risk assessment and health and safety plan?
- How do they intend to dispose of the waste product? Landfill? Have they approval for this?
- Is the waste product to be turned into fertiliser for farmers? If so, have any fa mers agreed to use such a product. Name them.

7. CONCLUSION

7.1. We cannot see any reason why this product should be allowed into NZ.

7.2. History suggests our agri-security is threatened by poor consideration of risks and use of the precautionary principle. We therefor strongly discourage the approval of this application to bring foreign manure and straw into New Zealand,

7.3. The application is for the sole benefit of three shareholders of Mercer Mushrooms

7.4. We **strongly** discourage the approval of this application to import mushroom growing medium, on all grounds aforementioned. If the proposal is approved and the products are allowed into NZ, the importer of this material must be responsible for any unforeseen consequences. This should include a minimum bond of NZ5M to cover any costs which may initially arise though any incursions.

7.5. How is it perceived that there a breach of 'fair trade' if the permits are not granted?

- Why would a fair trade deal necessitate NZ taking in a product which may have future ramifications for our country?

7.6. Under Section 3 (1) it is stated that we need to manage the importation of the mushroom growing medium in line with our international obligations. Really?

- What international obligations would require us to import something which we believe could be detrimental to our agricultural industry and to New Zealand? Please specify what these are.

7.7. Surely the role of MPI is to protect our country as much as it is to encourage the growth of the primary sector. The primary sector cannot grow if it is confronted with breaches of biosecurity. MPI must not accept the status quo without question, but become as tough and as unyielding as other nations in protecting our country's borders. All our futures depend on it.

7.8. We want the proposal to import this product stopped. No requirements, no inspections, no testing, no importing.

8. OUR GROUP

Hew Dalrymple, John Hodge, Colin MacKinnon, and David Clarke are all 'hands-on' farmers with each a strong and unerring interest in the future of New Zealand's billion dollar grain and arable industry and the economic well-being of New Zealand as a whole. Time and again they have been faced with the prospect of imports which can have, and have had, huge negative impacts on New Zealander's ability to farm. This must not continue.

DairyNZ

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8 February 2017

Animal Imports
Plant Imports
Ministry for Primary Industries
PO Box 2526
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By email to: animalimports@mpi.govt.nz and plantimports@mpi.govt.nz

DairyNZ submission on:

- **Draft Import Health Standard: Phase 3 mushroom growing medium**
- **Draft Import Health Standard: Processed animal manure products**
- **Risk Management Proposal: Phase 3 mushroom growing medium**
- **Risk Management Proposal: Processed animal manure products**
- **Import Risk Assessment: Phytosanitary Risks of Importing Phase III *Agaricus bisporus* Mushroom Compost**
- **Rapid Risk Assessment: Mushroom Substrate containing Horse and Poultry Manure**
- **Guidance Document: Phase 3 mushroom growing medium**
- **Guidance Document: Processed animal manure products**

Introduction

1. DairyNZ is the industry good organisation representing New Zealand's dairy farmers. Funded by a levy on milksolids and through government investment, our purpose is to secure and enhance the profitability, sustainability and competitiveness of New Zealand dairy farming. We deliver value to farmers through leadership, influencing, invest ng partnering with other organisations and through our own strategic capability. Our work includes research and development to create on-farm practical tools, leading on-farm adoption of best practice farming, promoting careers in dairying and advocating for farmers with central and regional government.

2. DairyNZ has looked at these consultation documents from the perspective of the overall management of animal health and biosecurity for the livestock industries in New Zealand. There are a number of diseases, pests and weeds not present in New Zealand that could potentially be imported with these products, but are of no relevance to the mushroom growing industry. These could affect the livestock and arable industries, therefore the impact of importing these organisms via mushroom growing medium and processed animal manure would extend well beyond the mushroom growing industry.

3. The dairy industry in New Zealand is a major exporter of milk products. Arrival of an exotic disease, weed or pest would not only impact on the health and productivity of the national dairy herd, but in all likelihood, would have serious ramifications for the industry's ability to export milk products. Annual export revenue for New Zealand from dairy products has ranged from $12.2 to $17 billion dollars over the last five years (June ended years), and this has accounted for 26-34% of New Zealand's merchandise trade annually (29% average on last five seasons). Loss of dairy export revenue would have a very significant impact on the country's economy.

Comments on these consultation documents

4. The draft Risk Management Proposal for Processed Animal Manure Products, section 2 Background, point 4, notes that MPI are looking to develop a generic IHS for processed animal manure products that will contain import requirements for all products containing animal manure. Animal manure can contain the infectious agents for a number of economically important animal diseases (for example Foot and Mouth Disease), as well as weed seeds, animal parasites and micro-organisms. Risk mitigation measures for such products will be essential to protect New Zealand's livestock and arable industries from diseases and pests not already present in the country. Effective risk mitigation is dependent on a robust risk analysis process to establish the relevant risks that need addressing. It is essential that expert advice is sourced for the risk analysis, and that the results are peer reviewed so that the necessary mitigation measures can be put in place to minimise the risk such imports pose to the livestock and arable industries.

5. The Import Risk Analysis document does not, in DairyNZ's view, cover the risk of importing plant seeds in sufficient detail. The weeds assessed are common in Europe and have seeds that are easy to inactivate in the temperature regime described. The Import Risk Analysis also needs to consider weeds species that have larger and hardier seeds, for example velvetleaf, and describe the temperatures, timeframes and moisture content required to neutralise these seeds. DairyNZ's view is that expert independent review of the proposed standards by a recognised New Zealand based pest plants scientist is required to inform the required Import Health standards, in particular minimum temperature and timeframe regimes required to be met throughout the composting process, to mitigate the risk of introduction of exotic plant species.

6. The risk mitigation process for both processed animal manure products and phase 3 mushroom growing medium is largely the composting process, with some specific time/temperature requirements to be met, and a need for strict hygiene at all phases of the process. Composting is an inherently variable process and we understand from a New Zealand study conducted by Plant and Food Research at Meadows Mushrooms, using bunkers of the same design and dimensions as those at Walkro International B.V., that at least 5% and potentially up to 20% of the compost does not reach the temperature thresholds required in the draft IHS. Part 2, (1) c, of the draft IHS states "…animal manure in the product has been composted at a temperature of 80^0 C, as measured by a sensor placed within the compost near the top of the pile, for no less than 72 hours." This implies only one sensor is needed to validate time/temperature requirements. DairyNZ believes that the use of a single sensor is insufficient to accurately assess whether minimum requirements have been achieved, given the variability of the composting process and the size of the compost pile (40

meters long). Ultimately, the described process provides no certainty of delivering the risk mitigation required.

7. The draft IHS also requires processes to be in place to ensure that the product does not become cross contaminated through contact with non-treated ingredients of animal origin after the first composting phase (section 1.6, (3)). There is no clarification as to how this should be achieved, or how this should be monitored. Compost is a bulky product that requires machinery such as front end loaders to move, and cleaning such equipment to a standard to prevent biosecurity breaches is extremely difficult. Dust and /or material spilled on access ways that may be shared between low risk and high risk machinery and personnel are also a concern.

8. Horse manure cannot be sourced from areas subject to animal health restrictions in accordance with Article 4(5) of EU Council Directive 2009/156/EC which covers management of glanders, vesicular stomatitis virus and anthrax. The Risk Management Proposal states "since the likelihood of exposure is considered to be negligible, the hazards are not assessed to be risks in the commodity." This means that control for two diseases of critical importance to the dairy industry, anthrax and vesicular stomatitis, relies entirely on compliance with an EU directive by people not associated with the export process. In addition, the Risk Management Proposal also states "the remaining equine hazards in horse manure are easily inactivated during the composting process", which, given, the variability in the composting process may not be the case. The pathway to farm for diseases (and seeds and micro-organisms) is well established as waste mushroom growing medium is commonly used as a compost and fertiliser by farmers and home gardeners in New Zealand.

9. DairyNZ is concerned that the risk mitigation measures for imported processed animal manure products and phase 3 mushroom growing medium described in these consultation documents will not deliver the protection required to the dairy industry to maintain its current excellent biosecurity status.

Thank you for the opportunity to comment on these consultation documents.

The primary contact for this submission is:

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SUBMISSION

FEDERATED FARMERS OF NEW ZEALAND

To: Plant Imports Team, Ministry for Primary Industries

PO Box 2526, Wellington 6140

Submission on: Phase 3 Mushroom Growing Medium Guidance Document (MPI.GD.PHASE3)

Phase 3 Mushroom Growing Medium Import Health Standard (MPI.IHS.PHASE3)

Date: 8 February 2017

Contact: Philippa Rawlinson

Policy Advisor

Federated Farmers of New Zealand

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SUBMISSION TO THE MINISTRY FOR PRIMARY INDUSTRIES ON PHASE 3 MUSHROOM GROWING MEDIUM GUIDANCE DOCUMENT (MPI.GD.PHASE3) AND PHASE 3 MUSHROOM GROWING MEDIUM IMPORT HEALTH STANDARD (MPI.IHS.PHASE3)

1. OUR SUBMISSION

1.1. Federated Farmers of New Zealand welcomes the opportunity to make this submission to the Ministry for Primary Industries (MPI) on their consultation documents for Phase 3 Mushroom Growing Medium Guidance Document (MPI.GD.Phase3) and Phase 3 Mushroom Growing Medium Import Health Standard (MPI.IHS.Phase3)

1.2. Our members take a keen interest in matters of biosecurity. It is paramount that we operate a system that ensures harmful pests and diseases are kept out of New Zealand. A biosecurity breach of any magnitude has the potential to impede our ability to remain a productive part of the New Zealand economy and to sell our product on the global market.

1.3. Federated Farmers views any new proposal to import material that may pose a biosecurity risk to New Zealand with caution. Federated Farmers would only be satisfied with the importation of mushroom growing medium if these products are subject to strict science-based biosecurity protocols that are rigorously implemented and enforced.

1.4. Federated Farmers is not convinced that the measures outlined in this proposed Import Health Standard are sufficiently robust to adequately address the risks associated with the importation of these products.

1.5. Federated Farmers opposes this Import Health Standard unless all our recommendations are met and the measures outlined adequately address the associated risks.

2. SUMMARY OF RECOMMENDATIONS

2.1. Federated Farmers submits that a list of regulatory requirements that sit outside the Import Health Standard should be included in the preamble section of the Import Health Standard.

2.2. Federated Farmers recommends that MPI reconsider the temperature thresholds and time to ensure that all biosecurity threats posed by this material are eliminated.

2.3. Federated Farmers recommends that any validation of the new temperature and time thresholds should be achieved using a simulated pathogen study to show that all the risk pathogens are neutralised by the composting process.

2.4. Federated Farmers recommends that a scientifically based temperature map study of the load should be undertaken at least three times, to show the required temperature is reached.

2.5. Federated Farmers recommends that samples of the composted material be drawn and checked for the presence of viable seeds. A germination test should be undertaken on seeds or parts of seeds that are detected.

2.6. Federated Farmers recommends that if the germination test is positive, no further consignments should be cleared for entry into New Zealand.

2.7. Federated Farmers supports an independent review of the proposed Import Health Standard by an independent New Zealand based scientist.

2.8. Federated Farmers recommends that MPI stringently monitors and audits the import pathway to ensure that all imported growing medium is free of viable weed seeds and any other material that poses a biosecurity risk.

2.9. Federated Farmers recommends that MPI actively and rigorously monitor the performance of any external accredited organisation and National Plant Protection Organisation (NPPO).

2.10. Federated Farmers submits that an annual audit and inspection is undertaken, and is a thorough and whole system audit.

2.11. Federated Farmers recommends that spent growing medium is not discharged onto land.

2.12. Federated Farmers submits that on arrival all consignments should be inspected by MPI.

3. PHASE 3 MUSHROOM GROWING MEDIUM IMPORT HEALTH STANDARD

3.1. In the preamble to the Import Health Standard on page 4 it states that "this is not an exhaustive list of compliance requirements and it is the importer's responsibility to be familiar with and comply with all New Zealand laws". Federated Farmers submits that a more complete list of regulatory requirements sitting outside the Import Health Standard that importers are required to comply with should be considered for inclusion in the preamble. Consolidating the full list of requirements will be a useful addition to help importers meet all compliance demands.

3.2. Part 1.4(1) states that all phase 3 mushroom growing medium must be free from regulated pests, extraneous materials and must not contain any viable weed seeds. Federated Farmers agrees with this statement, but we question whether the controls in the Import Health Standard are sufficient enough to achieve this goal.

3.2.1. According to Zaborski[1] (2015) field bindweed seeds were killed after seven days of heating at 82 degrees. Zaborski also notes that the higher the temperature which weed seeds are exposed to during the active phase of composting the higher the rate of weed seed mortality. Federated Farmers wishes to note that velvetleaf survives digestion by a chicken and is an extremely hardy seed known to survive the heating and milling process. Velvetleaf is abundant throughout Europe. Federated Farmers wishes MPI to

[1] Source: Zaborski, E. (2015) *"Composting to reduce weed seeds and plant pathogens"* accessed 2 February 2017, available from: http://articles.extension.org/pages/28585/composting-to-reduce-weed-seeds-and-plant-pathogens

note that the Netherlands has blackgrass resistant to a number of herbicides and we do not want this pest plant in New Zealand.

3.2.2. Federated Farmers understands that a study conducted by Plant and Food Research on Meadow Mushrooms showed that, using bunkers of the same design and dimensions as those at Walkro International B.V., at least 5 per cent and potentially up to 20 per cent of the compost does not reach the temperature thresholds proposed in the draft Import Health Standard. If the proposed conditions of the Import Health Standard are not being met in New Zealand, this does not fill us with confidence that they will be met by Walkro International B.V. Federated Farmers recommends that MPI reconsider the temperature thresholds and time to ensure that all biosecurity threats posed by this material are eliminated. Federated Farmers recommends that validation of the new temperature and time thresholds should be achieved by using a simulated pathogen study to show that all the risk pathogens are neutralised by the process.

3.2.3. Further Part 4.3(3)(a)(ii) states "in the first phase of production, the temperature of the compost (as measured by a sensor placed near the top of the pile), must reach approximately 80 degrees for a period of no less than 72 hours". This implies that only **one** sensor will be used to measure the temperature of all the material. A single sensor is completely inadequate for measuring and ensuring the requirements of the Import Health Standard have been met. Federated Farmers recommends that a scientifically based temperature map study of the load should be undertaken at least three times, to show that the required temperature is reached throughout the load.

3.2.4. To ensure that phase 3 mushroom growing medium is free from regulated pests, extraneous materials and viable weed seeds, Federated Farmers recommends that samples should be taken from multiple points in the composted material and checked for the presence of seeds or parts of seeds. A germination test should then be undertaken on the finds. If this germination test is positive, no further consignments should be cleared for entry into New Zealand until the importer complies with the requirements of the Import Health Standard.

3.2.5. Given the inherent uncertainties associated with the elimination of biosecurity risk posed by the importation of Phase 3 Mushroom Growing Medium, Federated Farmers recommends an independent review of the proposed Import Health Standard Phase 3 Mushroom Substrate by a recognised New Zealand scientist.

3.2.6. Federated Farmers seeks assurance that MPI will stringently monitor the import pathway to ensure that any imported growing medium is free from regulated pests and other material.

3.2.7. Federated Farmers urges MPI to keep an intense eye on changing production technologies and techniques associated with production of Phase 3 Mushroom Substrate. Often advances in technology or other matters are made before the relevant Import Health Standard can be modified. For example, the importation of pelletised seed has altered as a result of the contamination of pelletised fodder beet seed. The subsequent incursion response has cost Government millions and will continue to cost farmers in years to come.

3.2.8. In addition to surveying changing production technology and techniques, Federated Farmers also urges MPI to survey any emerging risks associated with the importation of this risk material.

3.3. Federated Farmers agrees with Part 1.5(1) which details that the NPPO of the exporting country provides evidence that the National Systems/Programmes and Standards used for export reassurance are in accordance with ISPM 7 Phytosanitary Certification System. Federated Farmers strongly supports and recommends MPI actively and rigorously monitoring the performance of NPPOs and their systems, programmes and standards. The velvetleaf in fodder beet incursion has taught us that despite an NPPO signing off an export consignment as free of contaminants and other material, sometimes this is not the case.

3.4. Federated Farmers submits that the wording of Part 1.5(2) should be amended to read "the national programmes and standards are subject to **annual** audit and **inspection** by MPI". Federated Farmers recommends that this is a thorough and whole systems audit rather than a desktop audit.

3.5. Part 1.8(1) contains a mistaken reference to Part 2.6: Post clearance conditions. It should reference Part 2.7 in the Import Health Standard which describes the post clearance conditions.

3.6. Part 2 describes some of the specific requirements that must be undertaken for the Phase 3 Mushroom Growing Medium before it can be imported. Federated Farmers has some particular concerns around Part 2 3(1)(a) which states the production system must include regular audits by an external accreditation body. Federated Farmers seeks further reassurance that the offshore processes will be undertaken as described and will be fully audited by MPI.

3.7. Federated Farmers has doubts that viable weed seeds will be denatured during the composting process as described in Part 2.3(1)(b) and subsequent processes to become Phase 3 Mushroom Growing Medium. To provide absolute surety that any viable weed seeds have been denatured, Federated Farmers recommends that an additional clause is added to Part 2.3(1)(b)(a) to read "samples from the composted material are undertaken and tested for any viable seeds". If the germination test is positive, no further consignments should be cleared for entry into New Zealand until the importer can prove they will comply with the requirements of the Import Health Standard.

3.8. Federated Farmers would be generally supportive of the Targeted Measures and system approaches discussed in Part 2.4. We do question what checks and balances will be in place to regularly monitor and reassure us that the proposed hygiene measures are undertaken thoroughly and will be monitored because in our opinion these will be hard to achieve.

3.9. Part 2.7(2) implies that the Phase 3 Mushroom Growing Medium does not receive biosecurity clearance and therefore must be retained at a Transitional Facility until it becomes spent growing medium and is treated to a steam cookout. We cannot distinguish from the text whether biosecurity clearance is given prior to the mushrooms being extracted. It is our view that all processing should take place in the transitional facility prior to any biosecurity clearance being given. The preference of Federated Farmers is this material should be neutralised before arriving in New Zealand and therefore any biosecurity risk is eliminated prior to the material arriving in New Zealand.

3.10. There is no description of what happens to the spent growing medium in the Import Health Standard or Guidance Material and any biosecurity risks that may still be associated with this product. The majority of the nutritional value will be removed when the spent mushroom growing medium is treated to a steam cookout, so the most obvious next step is to a landfill or discharged onto land. This carries some environmental risk. Given growing concerns over the quality of freshwater in New Zealand, we are unsure whether discharge onto land is the best option for the spent mushroom growing material. Federated Farmers submits that the spreading of spent growing medium should not be allowed onto farmland.

4. PHASE 3 MUSHROOM GROWING MEDIUM GUIDANCE DOCUMENT (MPI.GD.PHASE3)

4.1. Federated Farmers submits that Part 4.5(1) should be reworded to say "on arrival visual inspection of consignments will be undertaken for MPI to verify compliance with the requirements of the Import Health Standard". This amendment would provide additional reassurance to our members that all steps are being undertaken to ensure the biosecurity risk associated with the product is eliminated.

4.2. Post clearance conditions are detailed in depth by Part 4.6 and in much greater detail than the Import Health Standard provides. While we understand the Guidance Document is meant to be much more descriptive than the Import Health Standard, some of the Post clearance conditions detailed in this Guidance Document should be included in the Import Health Standard. We wish to reiterate our comments made in 3.11.

4.3. Federated Farmers agrees with the requirement for importers to keep records for seven years.

4.4. Part 4.6(3) should be amended to make reference to Part 2.7 of the Import Health Standard which relates to Post clearance conditions, rather than Part 2.6 as written which relates to Phytosanitary Inspection.

4.5 Federated Farmers agrees with Part 4.6(8) which provides MPI with the right to audit post clearance facilities to verify compliance with post audit conditions with little notice.

5. ABOUT FEDERATED FARMERS

5.1. Federated Farmers of New Zealand is a primary sector organisation that represents farmers, and other rural businesses. Federated Farmers has a long and proud history of representing the needs and interests of New Zealand farmers.

5.2. The Federation aims to add value to its members' businesses. Our key strategic outcomes include the need for New Zealand to provide an economic and social environment within which:

5.2.1. Our members may operate their businesses in a fair and flexible commercial environment;

5.2.2. Our members' families and their staff have access to services essential to the needs of the rural community; and

5.2.3. Our members adopt responsible management and environmental practices.

ENDS

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8 February 2017

SUBMISSION ON THE DRAFT IMPORT HEALTH STANDARD FOR PHASE 3 MUSHROOM GROWING MEDIUM

Submitter: Horticulture New Zealand Incorporated

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T: s 9(2)(a)

E: s 9(2)(a)

References:

A. Draft Import Health Standard Phase 3 Mushroom Growing Medium; MPI.IHS.PHASE3

B. Risk Management Proposal: New IHS for Phase 3 Mushroom Growing , 14 December 2016

C. MPI Import risk analysis: Phytosanitary Risks of Importing Phase III *Agaricus bisporus* Mushroom Compost from Northern Europe, 14 December 2016

D. Guidance Document, Phase 3 Mushroom Growing Medium MPI.GD.PHASE3

E. Plant and Food Research Report PFR SPTS No. 13965, Van der Keli G

EXECUTIVE SUMMARY

1. Horticulture New Zealand (HortNZ) represents the interests of New Zealand's 5,500 commercial fruit and vegetable growers. The horticulture industry is valued at over $5 billion including $3.3 billion in exports.

2. The industry employs over 60,000 people, occupies some 120,000 ha of land and provides critical regional development opportunities in Northland, Auckland, Bay of Plenty, Hawke's Bay, Marlborough, Nelson, Canterbury, and Central Otago.

3. Biosecurity supports production, secures market access, and provides confidence for investment – all key to the horticulture industry continuing to strive for achieving the Government's 'Export Double' goal, and the industry vision of $10billion by 2020.

4. Horticulture New Zealand:

- Supports the introduction of this IHS to manage the risk from imported Phase 3 mushroom compost
- Supports, in principle, the conclusions drawn from the RMP to specify the measures in the IHS
- Has two concerns regarding the measures intended to manage the risks posed; the basis for determining the time and temperature for destroying organisms, and the feasibility challenge posed to consistently achieve the desired composting time and temperature
- Support MPI conducting audits of offshore Pest Free Areas (PFAs)

BASIC MEASURES

5. HortNZ supports in principle the basic measures proposed in the IHS, with composting to manage the risk posed by the viable seeds and plant pests and disease organisms in raw ingredients (Ref B, para 71 (a) (b) (c), and para 72).

6. Ref B, para 73 states: The following attributes of commercial mushroom cultivation and growing medium production reduce the biosecurity risk associated with hazard organisms considered in this section of the RMP:

b) to produce phase 3 growing medium, all raw ingredients are composted at high temperatures (a maximum of around 80°C) for a minimum of 48 hours at high humidity (around 70%). Product is then pasteurised (for example at 57-60°C for 8-10 hours) to eradicate any disease organisms that may remain, and then conditioned at a lower temperature (for example 46-49°C for 48-72 hours) to remove free ammonia. This processing will reduce biosecurity risk associated with viable seeds, insects or plant disease organisms that may be present in the raw ingredients, especially when high temperatures are taken in combination with the primary decomposition that occurs during phase 1 and phase 2 production, and microbial antagonism or release of toxic products, as described in the MPI import risk analysis.

7. HortNZ takes this to mean that achievement of these temperatures is required to effectively manage the biosecurity risk, however the draft IHS sets a lower minimum time and temperature treatment. The Basic Measures, described in Ref A, require minimum time and temperature treatment of 60°C for 12 hours, or 65°C for 8 hours, not the "around 80°C for minimum 48 hours" as described in Ref B. HortNZ seeks further explanation of the basis for deriving the efficacy of the time and temperature treatment measures proposed in the IHS. We note the comment from Ref C, section 4.1.4:

it is essential to rely on temperature-time exposure for destruction (Hoitink & Fahy 1986)

8. HortNZ is however concerned about the commercial feasibility of achieving the required temperatures required for the treatment to be efficacious. Ref E identifies the challenges, at a New Zealand commercial composting facility, of consistently achieving temperatures throughout the entire lot of compost. HortNZ is concerned that there is uncertainty regarding the consistent achievement of the required temperature across the entire compost pile to ensure risk mitigation is achieved.

9. Ref C, section 4.1.4.1, describes the challenges associated with maintaining consistent temperatures within compost piles in particular the potential for pathogen survival

They noted that of greater concern for pathogen survival are the cool zones in static and in-vessel composting systems where there is no or little turning. Data sets analysed by Gale (2002) indicate that, of the composting green waste in turned-windrow and in-vessel systems, at least 20 and 5%, respectively, is below 55°C at any particular time.

10. Therefore whilst HortNZ supports composting as a mitigation measure for viable seeds and plant pests and disease organisms in raw ingredients, it is unclear as to what the effective time and temperature should be, and uncertainty exists about whether this is commercially feasible.

11. HortNZ recognises that commercial practice must include the need to prevent hazard organisms contaminating Phase 1 compost after treatment through strict hygiene measures, and supports this post treatment hygiene requirement, although we note the challenge of commercial achievement.

TARGETED MEASURES

12. HortNZ supports the Targeted Measures.

13. HortNZ is encouraged by MPI's commitment to audit the management of Pest Free Areas (PFAs) (Ref B, para 117) to verify the compliance with ISPM 4. Management of PFAs is an area about which HortNZ has previously expressed concern, and we commend MPI for taking this precedent setting step.

14. Ref B, para 119 also states that export from a facility will be suspended in the event of a targeted measure failure. HortNZ supports this policy on non-compliance where measures are clearly identifiable as failing (i.e. through pest or disease detection at NZ border).

EXPORT ELIGIBILITY

15. Ref B, para 81 states that if viable seeds are detected during a product inspection the batch will not be eligible for export, as this would be seen as evidence of systems failure. HortNZ supports the conclusion that detection of viable seed does evidence systems failure, however the consequence reflects on the batch, not the facility. HortNZ considers that in the event of such a detection, which represents a systems failure (including the failure by facility operators to monitor and confirm time and temperature achievement), the facility should be suspended pending review, corrective action, and re-audit. Continuing to allow the facility to export when such systems fa lure is in evidence would be negligent.

16. Ref B does not set out the export eligibility on detection of hazard pest and disease organisms. HortNZ expects that any detection should be considered a like failure as the detection of viable seeds.

POST CLEARANCE MEASURES

17. HortNZ supports the imposition of post clearance measures, including for the message it sends to importers about ongoing risk management. HortNZ supports the intent to have a Critical Control Point (CCP) for compost heat treatment but notes that Part3 of the IHS (Documentation) does not set out any records/verification documentation required to be kept for post-clearance measures.

CONCLUSION

18. HortNZ supports, in principle, the proposed IHS, and welcomes discussion with MPI in relation to the concerns rasied.

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Meadow Mushrooms Submission on:

- Draft Import Health Standard: Phase 3 Mushroom Growing Medium
- Draft Import Health Standard: Processed Animal Manure Products
- Guidance Document: Phase 3 Mushroom Growing Medium
- Guidance Document: Processed Animal Manure Products

February 2017

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Executive Summary

Thank you for the opportunity to provide comment on the Draft *Import Health Standards for Phase 3 Mushroom Growing Medium, and Processed Animal manure* and associated *Guidance Documents*, released for consultation on the 14th of December, 2016.

The mushroom industry in New Zealand directly employs approximately 800 people and retail earnings are approximately $NZ130 million per annum. Meadows is the largest producer of mushrooms in New Zealand.

We are concerned that the measures as currently written are not sufficient to protect New Zealand's mushroom industry from the potentially catastrophic effects of unwanted organisms. These include Mushroom Virus X and *Trichoderma aggressivum*, which have had a devastating impact on the mushroom industry in Europe (Bulman 2016, Fletcher & Gaze 2008). Specific details of our concerns are provided in this report. We are also concerned that other primary industries in New Zealand will be placed at risk. Our position is that MPI needs to place a hold on the importation of Phase 3 mushroom growing medium, until the efficacy of risk mitigation Measures can be clarified and strengthened.

We also have some concern as to the fact that the Draft *Import Health Standard for Phase 3 Mushroom Growing Medium* and associated *Guidance Document* have not, at the time of stakeholder consultation, undergone a structured process of peer review. We expect that the peer review process will result in substantive changes and, as such, request that MPI re-circulate penultimate drafts of both documents to its industry stakeholders for another consultation round, to allow submissions. This approach would be consistent with Section 23 of the Biosecurity Act 1993 and MPI's consultation policy (MPI 2016d).

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Table of Contents

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1 Import Health Standard for Mushroom Growing Medium

1.1 Import Health Standard for Phase 3 Mushroom Growing Medium, Section 2.3 Basic Measures; (1),b)

"Phase 1 composting must be done in enclosed bunkers, during which time all raw ingredients must be composted at a minimum temperature and time combination of either 60°C for 12 hours or 65°C for 8 hours."

The Import Risk Analysis for Phytosanitary Risks of Importing Phase III Agaricus bisporus Mushroom Compost from Northern Europe states that "*The only feasible option for treating compost for biological contaminants is heating*" (Ormsby 2016). This time-temperature relationship is sufficient to kill *T. aggressivum* and Mushroom Virus X, the two main pathogens / pathogen complexes of concern to the mushroom industry. However, literature quoted in MPI's Import Risk Analysis, and an independent study conducted by Plant and Food Research on the temperature profile of Meadows phase 1 bunkers, shows that the temperature of at least 5%, and potentially up to 20%, of the compost is well below the threshold required (Ormsby 2016, Van der Klei 2016). A copy of this report can be found in Appendix 1, pp 16-17.

Note: Meadows bunkers are 8 m wide x 8 m tall x 40 m long, enclosed and constructed of concrete, with ambient fresh air blown up through the floor (Van der Klei 2016). This is the same dimensions and design of the bunkers used by the Approved Production Plant referred to in the Draft Import Health Standard for Processed Animal Manure, Part 2 (2), a), Walkro International B.V., Blitterswijck (MPI 2016e).

Walkro have provided data they claim has been taken from the bottom of their phase 1 bunkers, at 10 cm, 20 cm, 30 cm and 40 cm from the floor, respectively (MPI 2016e). The same data is also referenced in the Import Risk Analysis: Phytos nitary Risks of Importing Phase III *Agaricus bisporus* Mushroom Compost from Northern Europe (Ormsby 2016). This data shows a markedly different pattern of temperatures compared to the literature referred to in the Import Risk Analysis (Ormsby 2016) and the independent study conducted on Meadows bunkers (Van der Klei 2016). The data was provided directly by Walkro, with no independent verification and it appears to contain some anomalies. For example, 3 days after phase 1 compos ing commenced, there is a 5-hour period where temperature increased by an average of 5 degrees Celsius per hour. A maximum rate of change of 1-2 degrees Celsius per hour is more typical in an enclosed phase 1 bunker, normally occurring 24-48 hours after phase 1 commences (den Ouden 2016).

It is critical that the temperature is measured at the coldest part of the bunker (Ormsby 2016). The coldest part of the bunker is in the zone closest to the floor, at the front of the bunker. (Ormsby 2016, Vander Klei 2016, MPI 2016e). Given the importance of the positioning of the probe, this should be clearly stated within the IHS.

Based on the information available, our preference would be to amend the IHS to state as follows:

"Phase 1 composting must be done in enclosed bunkers, during which time all raw ingredients must be composted at a minimum temperature and time combination of either 60°C for 12 hours or 65°C for 8 hours, measured by a probe positioned 10-20 cm above the bunker floor, 10-20 cm in from the front of the bunker."

1.2 Import Health Standard for Phase 3 Mushroom Growing Medium, Section 2.3 Basic Measures; (1),c),iii):

"**Procedures must be in place to remove all traces of compost debris from tunnels, conveyors, winches and other equipment between batches.**"

The Import Risk Analysis for Phytosanitary Risks of Importing Phase III Agaricus bisporus Mushroom Compost from Northern Europe clearly outlines the problems with this approach:

- "*While Measures such as cleaning can be implemented, to reduce the likelihood of such spread, experience in Northern Europe clearly illustrates the difficulties in preventing spread even when the knowledge of the potential risks are widely known and understood by industry*."
- "*Infested Phase 3 compost can infest transport vehicles and filling equipment, especially conveyors and filling heads that are difficult to clean*".

Even if heat treatment could be applied effectively, it is inevitable that infected compost material would be carried over from batches that have not been heat treated, into batches that have been heat treated. Very low rates of inoculum can cause devastating crop losses (Bulman 2016).

Increased hygiene measures in relation to the first phase of composting are required as a Basic Measure. This is discussed further in Section 1.5 of this report.

1.3 Import Health Standard for Phase 3 Mushroom Growing Medium, Section 2.4 Targeted Measures; (1),c)

"Systems Approach. The components of a systems approach, including the particular production facilities, should be documented in the Export Plan. MPI will audit the management of a systems approach for compliance ISPM14: *The use of integrated Measures in a systems approach for pest risk management*".

Table 1 sets out the requirements of IPPC ISPM14, and issues we have identified in respect of compliance with this Standard.

Table 1: Requirements of ISPM14, and compliance issues of the draft IHS.

Requirement of ISPM14	Compliance issues
Section 9, Evaluating Systems Approaches: "Possible outcomes of evaluation: These may include determination that the systems approach is: - acceptable - unacceptable: - efficacious but not feasible - not sufficiently effective (requires an increase in the number or strength of Measures) - unnecessarily restrictive (requires a reduction of the number or strength of Measures) - not possible to evaluate due to insufficient data or unacceptably high uncertainty."	According to this description, the Systems Approach put forward by MPI is unacceptable because the efficacy of the Measures cannot be evaluated due to insufficient data on heat treatment (as described in Section 1.1), and because uncertainty in the efficacy of these Measures is unacceptably high. Ormsby 2016, Section 4.2 states that *"There is considerable uncertainty about the efficacy of risk management Measures against the possible hosts of viruses and against microorganisms of potential economic concern"*.
Section 2: Characteristics of a Systems Approach: "A systems approach requires two or more Measures that are independent of each other" Section 4: Independent and Dependent Measures: "Where Measures are independent of each other, both Measures must fail for the system to fail"	Proposed Measures in the IHS are not independent. - Heat treatment is one proposed Measure. - Heat treatment and the proposed Measures for improved hygiene are not independent. This is because the efficacy of the Measures for hygiene rests on the assumption that the substrate has been heat treated. Thus, if heat treatment fails then the Measures for improved hygiene will also fail. - Testing is problematic and only assesses a minute fraction of the material produced (discussed further in sections 1.6, 1.8 and 1.9 of this document). Therefore in this situation, neither hygiene nor testing will provide an independent Measure that will prevent system failure.

Requirement of ISPM14	Compliance issues
Section 2 Characteristics of a Systems Approach: "Measures used in a systems approach may be applied pre and/or post-harvest wherever national plant protection organisations (NPPOs) have the ability to oversee and ensure compliance with phytosanitary procedures"	In this instance the NPPO needs to be directly involved to oversee and ensure compliance for pre- and post-harvest Measures, as we are very concerned that the requirements of the IHS may not be adhered to, for the following reasons: - There have already been instances of incorrect information supplied by the exporter/manufacturer (MPI 2016d), and neither the Netherlands NPPO, nor MPI detected that the information was incorrect until several months later. - The Phase 1 process at Walkro's production plant is not always the same varying from 3 to 6 days, as per information supplied by MPI on the 16th February 2016 under an Official information Act request, entitled "Walkro Production process". - The compost is sold to a third party (DTO) that is not directly involved in production, and it is then on-sold to New Zealand (information supplied by MPI on the 16th February 2016 under an Official information Act request, entitled "DTO Substrate: Declaration of Hygienic Process Mushroom Substrate"). DTO facilities and processes should be assessed to determine whether appropriate Measures and systems are in place to provide confidence that all requirements of the IHS are being met at all stages of the import process.
Section 6, Types of Systems Approaches: "The minimum requirements for a Measure to be considered a required component for a systems approach are that the Measure: - is clearly defined - is efficacious - is officially required (mandatory) - can be monitored and controlled by the responsible NPPO"	Some of the Measures described in the IHS do not meet this requirement. For example: - Temperature and time requirements are specified, but there is no clear requirement for the measurements to be taken at the coldest part of the bunker, which is critical when using heat treatment (Ormsby 2016). - The time-temperature specification cannot be met (as described in Section 1.1), and therefore will not be efficacious.

Requirement of ISPM14	Compliance issues
Section 7, Efficacy of Measures: "The overall efficacy of a systems approach is based on the combination of the efficacy of the required independent Measures. Wherever possible this should be expressed in quantitative terms with a confidence interval. For example, efficacy for a particular situation may be determined to be no more than five infested fruit from a total population of one million fruit, with 95% confidence."	The IHS does not specify a confidence interval for the efficacy of any of the proposed Measures. This would need to be developed through sampling and statistical analysis. Phase 3 compost is a completely new and unknown import for New Zealand. Phase 1 is not typically used as a heat treatment step in mushroom composting, so the time-temperature requirements proposed need to be more fully evaluated. These requirements also need to be strengthened to account for the risks associated with data gaps, variability in data and lack of experience importing this commodity.

We note (Import Health Standard item 1.6 [items 1 and 2]) that, "*MPI and the exporting country NPPO may negotiate a country-specific Export Plan that demonstrates how Targeted and MPI- Specified Measures will be achieved before trade can commence*" and that, "*If, for operational reasons, the NPPO of the exporting country is unable to negotiate an Export Plan, MPI may negotiate the Export Plan directly with another relevant party*". We request that MPI provide ourselves and other industry members with the opportunity to comment on any Export Plans that are negotiated with exporting country NPPOs or other parties.

1.4 Import Health Standard for Phase 3 Mushroom Growing Medium, Section 2.4.2 Systems approach (2),a),i)

"Where a systems approach is used as a Targeted Measure, the Export Plan must include the following components: i) steaming phase 2 and 3 production tunnels at a minimum of either 60°C for 12 hours or 65°C for 8 hours between each crop."

Steam can be used both during the second phase of composting (pasteurisation) and when the third phase is complete and the tunnels have been emptied (cook out). A cook-out is a steam sterilisation process. Pasteurisation temperatures do not typically achieve the threshold levels (60°C for 12 hours or 65°C for 8 hours), but within the industry can often be used in place of cook out because it is more cost effective. But it will not be sufficient to destroy *T. aggressivum* and MVX.

To remove ambiguity the IHS should specify steam sterilising.

1.5 Import Health Standard for Phase 3 Mushroom Growing Medium, Section 2.4.2 Systems approach (2),a),ii),iii),iv),v),vi),vii)

"Where a systems approach is used as a Targeted Measure, the Export Plan must include the following components: i) steaming phase 2 and 3 production tunnels at a minimum of either 60°C for 12 hours, or 65°C for 8 hours between each batch; ii) cleaning and chemical disinfection of other parts of phase 2 and phase 3 production areas between batches; iii) maintaining positive air pressure during spawning; iv) HEPA filtration of spawning areas; v) isolating spawning from other stages of production; restricting entry to production tunnels; vii) using clean clothing and footwear when entering production areas."

The Import Risk Analysis for Phytosanitary Risks of Importing Phase III Agaricus bisporus Mushroom Compost from Northern Europe states that, "*hygiene methods have a mixed level of success in preventing MVX contamination*".

All of these Measures relate to the second phase of the process, which is the recognised heat treatment step in mushroom composting. They are designed to prevent contamination of compost post-heat treatment. However, the IHS is proposing that the first phase of composting be used as a heat treatment step. So all of these hygiene requirements listed above, designed to prevent post-treatment contamination, need to be applied to the first phase.

The information supplied in an Official Information Request from MPI on 16th February 2016, entitled included "*Walkro Production Process*", describes the cleaning protocols for phase 1. Table 2 sets out the requirements specified in the Systems Approach, and the deficiencies in the existing cleaning protocols.

The IHS needs to specify that the hygiene requirements as listed in section (2) a) of the draft IHS are included as Basic Measures rather than Targeted Measures, and that they are applied to the first phase of the composting process.

Table 2: Systems Approach – hygiene requirements and cleaning protocol deficiencies in Phase 1.

Systems Approach	**Cleaning protocol deficiencies**
Steam sterilising facilities between each crop	Not specified
Cleaning and chemical disinfection	Cleaning with water only
Maintaining positive air pressure	Not specified
HEPA filtration	Not specified
Using clean clothing and footwear when entering production areas	Not specified

1.6 Import Health Standard for Phase 3 Mushroom Growing Medium, Section 2.4.2 Systems Approach (2),b),i)

"the Export Plan must include the following components: i) testing samples of phase 3 mushroom growing medium taken during tunnel emptying for the presence of *T. aggressivum*"

Section 5.2.3.1 of The Import Risk Analysis for Phytosanitary Risks of Importing Phase III Agaricus bisporus Mushroom Compost from Northern Europe states the following difficulties associated with testing for *T aggressivum* in compost:

- "*Culture based screening of compost and raw materials is a method for monitoring Trichoderma levels on a farm or composting facility, however species assignment in such cases is usually presumptive (O'Brien 2012). The taxonomy of the genus Trichoderma is complex and many Trichoderma species are difficult to identity to species level based on microscopic examination of morphological characteristics. Molecular PCR-based techniques have been used to differentiate between the ubiquitous T. harzianum (Th1) and T. aggressivum f. europaeum, previously known as T. harzianum (Th2) and this method is useful for identifying pure cultures of T. aggressivum isolated from mushrooms or compost but it is not very successful for detecting T. aggressivum in compost samples*."
- "*even when using the most sensitive testing methods, false negatives were reported*".

A report by Dr. Simon Bulman (Plant and Food Research) is appended to this document (Appendix 2). This describes further problems associated with testing for *T. Aggressivum*, including that:

- Small volumes of material needed for qPCR may not be representative of the compost as a whole;
- During spawn-run the compost is largely inaccessible and therefore it is difficult to collect representative samples for testing purposes.

The problems associated with testing (Ormsby 2016, Bulman 2016) are well understood within the industry, and it is for this reason work has been ongoing to develop a detection test based on volatiles released by *T. aggressivum*, (Ormsby 2016) but this test is not yet available commercially (Bulman 2016).

The Import Risk Analysis also highlights the persistence of this disease in commercial composting facilities:

- "*Infestation of Phase 3 compost by T. aggressivum is difficult to prevent in commercial composting facilities*"
- "*European commercial mushroom producers experience difficulties preventing contamination and spread of T.aggressivum even with high industry awareness*"
- "*Even a small pocket of T.aggressivum infected compost in a Phase 3 tunnel has the potential to affect a much greater proportion of that compost as a result of various opportunities for mixing and diluting the infected compost into the un-infected compost. Under these circumstances the T.aggressivum infected compost is unlikely to be "visible" therefore no alarm will be raised*"

In order to be effective, the IHS needs to specify a sampling and testing protocol that is known to detect minor or localised infections with a high degree of confidence. As the literature states, such testing protocols are still under development (Bulman 2016).

1.7 Import Health Standard for Phase 3 Mushroom Growing Medium, Section 2.4.2 Systems Approach (2),b),iv)

"the Export Plan must include the following components: post production monitoring (at local mushroom production facilities who receive material from the same batch of growing medium) to determine any presence of *T.aggressivum*"

Localised infections within a compost batch may affect one farm, but not another. The Import Risk Analysis for Phytosanitary Risks of Importing Phase III Agaricus bisporus Mushroom Compost from Northern Europe states that, "*There is a distinct possibility that growers receiving compost from one area of the tunnel may crop very well while growers receiving compost from a more contaminated area of the tunnel may experience total yield loss leading to a false conclusion that the compost is not the source.*"

Infection at other farms receiving the same batch of compost may not be reported due to commercial sensitivities. The IHS and Export Plan should stipulate that other farms receiving compost from the same batch must be inspected and audited to provide an acceptable degree of confidence about the occurrence of infections.

Given the difficulties associated with this approach as a Risk Management Measure, stronger emphasis must be placed on comprehensive, independent testing of compost batches prior to export.

1.8 Import Health Standard for Phase 3 Mushroom Growing Medium, Section 2.4.2 Systems Approach (2),c)

"the identity of any species of Trichoderma identified during testing must be confirmed using PCR or DNA sequencing"

Trichoderma species are extremely common in the environment. The Import Risk Analysis states that, "*Ascomycete fungi of the genus Trichoderma are ubiquitously distributed in nature and commonly account for the majority of fungi cultured from soil samples.*" Regular detection of *Trichoderma* is inevitable if a testing programme is comprehensive, and this will impose considerable additional cost on the manufacturer. Compliance to this requirement will also be difficult.

The IHS should be amended to ensure that each consignment of phase 3 compost is tested, and that each consignment is accompanied by independently-verified results confirming the absence of *T. aggressivum*. The testing protocol required should be statistically justified and shown to be capable of detecting minor or localised infections with a high degree of confidence. Given the difficulty in using PCR to detect infections within compost (Ormsby 2016), the testing protocol should also specify that any species of Trichoderma species are isolated from compost first, before a PCR test is conducted.

1.9 Import Health Standard for Phase 3 Mushroom Growing Medium, Section 2.4.2 Systems Approach (2),d)

"Samples from every batch of phase 3 compost medium must be tested for the presence of signs or symptoms of Mushroom virus X disease."

Testing for MVX is problematic, and may result in an unacceptable rate of false positives and negatives. The Import Risk Analysis for Phytosanitary Risks of Importing Phase III *Agaricus bisporus* Mushroom Compost from Northern Europe states that,

- "*MVX is a virus complex of which not all members have necessarily been identified or fully characterised. Testing for a selected few of the members of the complex may not ensure other members do not enter on Phase 3 mushroom compost or on other forms of inoculum imported into New Zealand*"
- "*detection of any contamination either by testing or through symptom expression during mushroom production may not occur for some time after export. For these reasons it may be difficult to ensure production sites remain free of MVX without a continuous and comprehensive testing regime*"
- "*the success of any Measures on the domestic mushroom production facilities to ensure any imported contaminated compost does not result in the establishment of MVX in New Zealand, are also limited by the efficacy of hygiene and detection methods*".

In keeping with the tenets of IPPC ISPM14 section 9 (Evaluating Systems Approaches), this Measure as part of a systems approach is unacceptable as the efficacy of the Measures cannot be evaluated – that is, the testing method proposed is insufficient to ensure MVX is absent from imported consignments.

The IHS should be amended to specify a testing protocol for MVX that is independently verified, statistically justified and shown to be capable of detecting minor or localised infections with a high degree of accuracy.

1.10 Import Health Standard for Phase 3 Mushroom Growing Medium, Section 3.3 Manufacturers certificate (1),e),i),ii)

"A manufacturer's certificate is required and must be signed by an authorised person within the company and must include the following information: a statement that monitoring and/or testing for *T. aggressivum* and Mushroom Virus X disease has been completed as required in the IHS, and that neither organism has been detected."

Our concern with this requirement is that the authorised person is not independent from the company. The IHS for Processed Animal Manure products requires an independent and suitably qualified person to verify that the time-temperature requirements of the IHS have been met, and that written confirmation of this will be supplied with each consignment.

IPPC ISPM14 Section 2 (Characteristics of a Systems Approach) states that, "*Measures used in a systems approach may be applied pre and/or post-harvest wherever national plant protection organisations (NPPOs) have the ability to oversee and ensure compliance with phytosanitary procedures*".

A consistent approach, compliant with the requirements of ISPM14, must be applied in order to verify that the requirements of the IHS have been met. The IHS should specify that the person providing verification must be independent and suitably qualified, and written confirmation of the independent verification must be provided with each consignment.

2 Guidance Document for Phase 3 Mushroom Growing Medium

2.1 Guidance Document for Phase 3 Mushroom Growing Medium, Section 4.6 Post clearance conditions (2),a)

"All waste packaging material associated with imported growing medium must be disinfected onsite by immersion in a disinfectant that is recognised to be effective against fungi and viruses that may be present in close association with organic matter."

Disinfectants are not effective on porous material such as compost. This is noted in the Import Risk Analysis for Phytosanitary Risks of Importing Phase III *Agaricus bisporus* Mushroom Compost from Northern Europe, where it is explained that,

- "*While disinfectant can be used to kill fungi, tests confirm it is not possible to kill all mycelium in compost using disinfectants. Even high levels of biocides for prolonged periods of time cannot reduce fungal or bacterial populations to zero in compost. Therefore all compost, casing soil and any other organic matter must be removed before disinfecting*".

The Guidance Document must specify that:

- all traces of organic matter are to be removed from the packaging and contained to be heat treated later,
- once cleaned, all packaging is to be disinfected

2.2 Guidance Document for Phase 3 Mushroom Growing Medium, Section 4.6 Post clearance conditions (2),b)

"All machinery that is used to process imported medium must be thoroughly cleaned after each use to remove all traces of organic matter. Any waste product that is removed during cleaning must be stored in a sealed container until the final crop of mushrooms from that batch of growing medium has been harvested, after which time it may be disposed of with the spent growing medium"

We are concerned that washing of equipment (as described in the Import Risk Analysis for Phytosanitary Risks of Importing Phase III *Agaricus bisporus* Mushroom Compost from Northern Europe) is technically difficult, and that copious amounts of water are needed to remove all organic matter. Any cleaning residue will also be difficult to contain, and difficult to heat treat. The Guidance Document should recognise these difficulties and explain how the method will be applied.

The Import Risk Analysis states that the following measures should be applied to all facilities, "*Decontaminate all compost handling facilities and equipment between batches*". The Guidance Document must specify that the importer decontaminate all compost handling facilities.

2.3 Guidance Document for Phase 3 Mushroom Growing Medium, Section 4.6 Post clearance conditions (2),c),d),e)

"Procedures must be put in place to ensure that any equipment or machinery used within growing rooms during mushroom production is: i) retained within that room, OR; ii) treated with a disinfectant that will be effective against fungi and viruses before removal from the room. d) The importer must put in place steps to ensure that all personnel entering growing rooms in which imported medium is being used: i) wear protective clothing that is either retained within the growing room or discarded into a sealed waste bin on exit; AND ii) wear protective shoe covers or dedicated footwear that must be retained within each growing room; AND iii) wear disposable gloves that are discarded into a sealed waste bin on exit; AND iv) use footbaths or absorbent foot mats when entering and exiting each growing room. e) The importer must ensure that any discarded clothing is disinfected as described in clause (2)a) of these post clearance conditions before final disposal."

The controls for containing imported Phase 3 compost described in the Guidance Document relate to equipment and personnel. However, many tonnes of mushrooms and mushroom packaging will leave the rooms and the facility untreated. Mushrooms may be infected but asymptomatic.

The Import Risk Analysis states that, "*symptom expression can be sporadic, transient and unpredictable, facilities can be infested and act as a source of infection for other facilities before the presence of T.aggressivum is confirmed*", and in relation to MVX, that, "*detection of compost production site contamination may be delayed for some time after infestation*" (Ormsby 2016). These asymptomatic, infested mushrooms will then be distributed throughout New Zealand. In keeping with the tenets of IPPC ISPM14, Section 9 (Evaluating Systems Approaches) this Measure as part of a systems approach is unacceptable as it will not be sufficiently effective.

The Guidance Document therefore requires an increase in the number or strength of additional Measures to be compliant with IPPC ISPM14

2.4 Guidance Document for Phase 3 Mushroom Growing Medium, Section 4.6 Post clearance conditions (2),f)

"A suitably qualified and experienced employee of the importer must be appointed to undertake daily inspections of the phase 3 growing medium once it has been processed and transferred to growing rooms. This must include visual inspection of all growing medium on each layer of shelving to ensure that there are no visible signs of T. aggressivum. Once fruiting bodies become visible, inspections must also look for signs or symptoms of MVX."

IPPC ISPM14, Section 2 (Characteristics of Systems Approaches) states that, "*Measures used in a systems approach may be applied pre and/or post-harvest wherever national plant protection organisations (NPPOs) have the ability to oversee and ensure compliance with phytosanitary procedures*".

The draft IHS for Processed animal manure (Section 1.8, (1), a) v)) requires independent verification that requirements are being met (MPI 2016a).

"The consignment must arrive in New Zealand with the following documentation. a) A veterinary certificate that must include the following: i) A unique consignment identifier. ii) The description, source species, and amount of product. iii) The name and address of the importer (consignee) and exporter (consignor). iv) The name, signature, and contact details of the Official Veterinarian. v) Certification and endorsement by the Official Veterinarian that the Requirements and the General Processing Requirements outlined in Parts 1 and 2, respectively, of this IHS have been met."

A consistent approach that is compliant with the requirements of ISPM14 needs to be applied with respect to verification that the requirements of the IHS are met.

The IHS should specify that the person providing verification must be independent and suitably qualified, and written confirmation of the independent verification must be provided with each consignment.

2.5 Guidance Document for Phase 3 Mushroom Growing Medium, Section 4.6 Post clearance conditions (2),g),i)

"if any signs of contamination by any species of Trichoderma are detected in a growing room, representative samples must be taken and sent by courier to MPI's Plant Health & Environment Laboratory for confirmation of identity."

The Import Risk Analysis states that, "*The taxonomy of the genus Trichoderma is complex and many Trichoderma species are difficult to identity to species level based on microscopic examination of morphological characteristics. Molecular PCR-based techniques have been used to differentiate between the ubiquitous T. harzianum (Th1) and T. aggressivum f. europaeum, previously known as T. harzianum (Th2) and this method is useful for identifying pure cultures of T. aggressivum isolated from mushrooms or compost*" (Ormsby 2016).

PCR is the only recognised method for confirming the presence of *T. aggressivum* in compost, and it requires a positive con rol, i.e. a sample of *T. aggressivum* to compare with. As this is a regulated pest, New Zealand laboratories may not have access to positive controls.

The Guidance Document must specify a reference laboratory that has the capability to confirm species identity by PCR.

n addition, *Trichoderma* species are extremely common in the environment, such that regular visual detection is almost certain. To ensure that every *Trichoderma* colony that is visually detected is then PCR tested to confirm species will be necessary, but difficult to comply with, so independent oversight will be crucial.

The Guidance Document should specify that compliance to this requirement will be independently audited and verified.

2.6 Guidance Document for Phase 3 Mushroom Growing Medium, Section 4.6 Post clearance conditions (2),h),i),ii),iii),iv),v)

"If signs or symptoms of either T. aggressivum or MVX are suspected at any time, the importer must i) immediately secure the growing room and prevent any material being transferred to other areas of the facility – this must include sealing all entry and exit points for ventilation into the affected room; AND ii) immediately notify the MPI pests and diseases hotline on 0800 80 99 66; AND iii) ensure that no machinery or equipment used for producing or transporting mushrooms is removed from the site until further notice from MPI; AND iv) ensure that no produce is removed from the site until further notice from MPI; AND v) ensure that any personnel who have entered the growing area where either disease was detected do not enter any other areas within the facility. Any protective clothing worn by personnel that may have been contaminated must immediately be decontaminated in a way which will destroy the disease organism of concern, for example as described in clause (2)a) of these post-clearance conditions, before final disposal."

There is no control imposed on mushrooms and packaging that have been released from the growing room or facility where the Phase 3 compost will be used / grown. The Import Risk Analysis states that, "*symptom expression can be sporadic, transient and unpredictable, facilities can be infested and act as a source of infection for other facilities before the presence of T.aggressivum is confirmed*" and in relation to MVX, that "*detection of compost production site contamination may be delayed for some time after infestation*".

The Guidance Document must state that, if signs or symptoms of *T. aggressivum* or MVX are detected, all mushrooms and packaging harvested and distributed from the affected rooms must be recalled to be contained and treated.

3 Import Health Standard for Processed Animal Manure

Meadows is intimately knowledgeable on the mushroom composting process and so would like to provide comment on the draft Import Health Standard for Processed Animal Manure, as we believe there may be significant risks for other industries in New Zealand. Our understanding is that representatives from other industries that are directly impacted will also be submitting.

3.1 Import Health Standard for Processed Animal Manure, Section "Other Information"

"Importers of mushroom growing medium containing horse and chicken manure inoculated with viable microorganisms (such as mushroom spawn) will also need to comply with the requirements in the Import Health Standard for Microorganisms from All Countries (MICROIC.ALL)."

Compost is a material comprising many different microorganisms. A recent study conducted by Dr Michael Kertesz from University of Sydney looked at characterising the microorganisms within mushroom compost. His work identified 571 different organisms in Phase 3 compost, however only 54 of these were able to be characterised to species level (Kertesz 2016, pers.comm). Of this 54, 1 is listed on MPI's unwanted organisms register, *Bacillus badius*. There are an additional 34 organisms identified to the genus level, that are the same genus as over 123 species on MPI's unwanted organisms register. This includes organisms of the genus, Agrobacterium, Bacillus, Burkholderia, Enterobacter, Mycobacterium, Paenibacillus, Pantoea, Pseudomonas, Sphingomonas, Streptomyces. (Pers comm. Kertesz 2016). In addition, species of the genus Actinomycetes and Erwinia are known to be associated with Agaricus bisporus mushrooms (Fletcher & Gaze 2008, Beyer 2017), of which there are an additional 30 species on MPI's unwanted organisms list.

Further evaluation of the microorganisms present within Phase 3 compost is required to understand this import risk.

3.2 Import Health Standard for Processed Animal Manure, Section 1.6 (3)

"After composting to 80°C for no less than 72 hours and prior to the final packaging, the mushroom growing medium containing horse and chicken manure may be transferred to other parts of the production plant or to other production sites as long as processes are in place to ensure the product does not become contaminated by further ingredients of animal origin"

Prevention of contamination of treated material with untreated material is critical. The "processes" referenced above need to be more clearly defined. Phase 2 of the composting process does typically include multiple hygiene measures to prevent cross contamination as this is the recognised heat treatment step. The IHS should be amended to prescribe the necessary Measures, as per Section 1.5 of this report.

3.3 <u>Import Health Standard for Processed Animal Manure, Section 2 (i) c)</u>

"During the first phase of production, the animal manure has been composted in enclosed concrete compartments for a period of no less than five days. During this phase of production the animal manure in the product has been composted at a temperature of 80°C, as measured by a sensor placed within the compost near the top of the pile, for no less than 72 hours."

There is evidence to show that this temperature threshold will not be achieved, as described in Section 1.1 of this report. The clause above should be amended to ensure that the temperature is measured at the coldest part of the bunker. If a single probe is to be used, it must first be independently verified that the singular probe is consistently representative of the coldest part of the bunker.

3.4 <u>Import Health Standard for Processed Animal Manure, Part 2 (2) a)</u>

"The approved production plant is: a) Walkro International B.V., Veerweg 11, 5863 AR, Blitterswijck, The Netherlands"

The approved plant in the draft Import Health Standard for Processed Animal Manure is currently the subject of an investigation into the supply of false information on the ingredients used to make Phase 3 Mushroom Compost. Animal manure was not declared, and imports commenced, placing New Zealand at considerable biosecurity risk.

Approval status of this plant should be suspended until the investigation is complete. If the investigation reveals any direct involvement of Walkro in the supply of false information, their approval status should be revoked.

4 Guidance Document for Processed Animal Manure

4.1 <u>Guidance Document for Processed Animal Manure, Section 6 Model Veterinary Certificate</u>

As per section 3.3 of this report, the Guidance Document needs to be amended to reflect the change in requirements for the measurement of compost temperature.

5 Summary Conclusions

Trichoderma aggressivum and Mushroom Virus X have managed to spread throughout Europe, despite industry awareness of the severity of the impacts they have had on the mushroom industry. 'Our concern is that the Measures proposed by MPI do not reduce the biosecurity risk associated with Phase 3 Mushroom Compost to an acceptable level. This could have catastrophic consequences for our industry.

Our position is that MPI needs to place a hold on the importation of Phase 3 mushroom growing medium, until the efficacy of proposed control Measures can be further evaluated, by:

- Requiring the exporter to provide independently verified, detailed data of the temperatures achieved in phase 1 composting, with the objective of clearly determining whether the time-temperature requirements can be met, with a satisfactory level of statistical confidence.
- Requiring the exporter to provide evidence of proactive investigation and testing specifically for *Trichoderma aggressivum* and Mushroom Virus X within their facility, and a history of independently verified negative test results.
- Requiring more robust testing methods to confirm that *Trichoderma aggressivum* and Mushroom Virus X are absent in compost batches destined for New Zealand. The latest literature suggests that such testing methods are currently under development

Notwithstanding the above, the following summarises the changes we believe are necessary to the Draft Import Health Standard for Phase 3 Mushroom Compost and associated Guidance Document:

1. IHS Section 2.3 Basic Measures; (1),b) should be amended to read: "Phase 1 composting must be done in enclosed bunkers, during which time all raw ingredients must be composted at a minimum temperature and time combination of either 60°C for 12 hours or 65°C for 8 hours, measured by a probe positioned 10-20 cm above the bunker floor, 10-20 cm in from the front of the bunker."
2. IHS Section 2.3 Basic Measures; (1),c),iii) should be amended to read "Procedures must be in place to prevent cross contamination of treated and untreated material. This includes: steam sterilising of bunkers at a minimum of either 60°C for 12 hours, or 65°C for 8 hours between each batch; cleaning and chemical disinfection of other parts of phase 1 production areas between batches; maintaining positive air pressure during emptying; HEPA filtration of phase 1 areas; isolating phase 1 from other stages of production; restricting entry to phase 1 production areas; using clean clothing and footwear when entering phase 1 production areas. Records of this must be kept."
3. IHS Section 2.4.2 Systems Approach (2),b),i), should be amended to read "the Export Plan must include the following components: i) independently verified testing of each batch of phase 3 mushroom growing medium for the presence of *T. aggressivum*, using a method that provides a high degree of confidence that compost batches destined for New Zealand are free from *T aggressivum*"

4. IHS Section 2.4.2 Systems Approach (2),c), should be amended to read: "the identity of any species of *Trichoderma* identified must be confirmed, by first culturing a pure strain, and then using PCR or DNA sequencing
5. IHS Section 2.4.2 Systems Approach (2),d),should be amended to read: "Samples from every batch of phase 3 compost medium must be independently tested for the presence of signs or symptoms of Mushroom virus X disease, using a method that provides a high degree of confidence that compost batches destined for New Zealand are free from MVX."
6. IHS Section 3.3 Manufacturers certificate (1),e),i),ii), should be amended to read: "A manufacturer's certificate must be supplied with each consignment, it must be signed by an independent and suitably qualified person and must include the following information: a statement that monitoring and/or testing for *T. aggressivum* and Mushroom Virus X disease has been completed as required in the IHS, and that neither organism has been detected."
7. Guidance Document, Section 4.6 Post clearance conditions (2),a), should be amended to read: "All waste packaging material associated with imported growing medium must be cleaned, and all traces of organic matter contained to be heat treated later. Cleaned packaging must then be disinfected onsite by immersion in a disinfectant that is recognised to be effective against fungi and viruses that may be present in close association with organic matter."
8. Guidance Document, Section 4.6 Post clearance conditions (2),b) should be amended to read: "All machinery that is used to process imported medium must be thoroughly cleaned after each use to remove all traces of organic matter. Any waste product that is removed during cleaning must be stored in a sealed container until the final crop of mushrooms from that batch of growing medium has been harvested, after which time it may be heat treated and disposed of with the spent growing medium. Once cleaned, all machinery must be disinfected onsite using a disinfectant that is recognised to be effective against fungi and viruses that may be present in close association with organic matter"
9. Guidance Document, Section 4.6 Post clearance conditions (2),f), should be amended to read: "An independent and suitably qualified person must undertake daily inspections of the phase 3 growing medium once it has been processed and transferred to growing rooms. This must include visual inspection of all growing medium on each layer of shelving to ensure that there are no visible signs of *T. aggressivum*. Once fruiting bodies become visible, inspections must also look for signs or symptoms of MVX. Records must be kept of such inspections."
10. Guidance Document, Section 4.6 Post clearance conditions (2),g),i), should be amended to read: "if any signs of contamination by any species of Trichoderma are detected in a growing room, representative samples must be taken and sent by courier to a Laboratory with the capability to confirm species identity by PCR. Compliance to this requirement will be regularly audited and verified by an independent and suitably qualified person."
11. Guidance Document Section 4.6 Post clearance conditions (2),h),i),ii),iii),iv),v), add "any mushrooms produced from the affected facilities are to be recalled and contained within the site to be heat treated"

References:

Beyer, D. (2017) Microbial Activity, Penn State Extension. The Pennsylvania State University http://extension.psu.edu/plants/vegetable-fruit/mushrooms/mushroom-substrate/microbial-activity

Bulman, S. (2016) Trichoderma and MVX in mushroom compost. Plant and Food Research, Christchurch, New Zealand. See Appendix 1.

den Ouden, M. (2016) Mushroom Signals: A practical guide to optimal mushroom growing. Chapter 1: Phase 1, fresh compost. Pp 16-33. Roodbont Publishers, The Netherlands.

Fletcher J.T., Gaze R.H. (2008) Mushroom Pest and Disease Control: A Colour Handbook. Manson Publishing Ltd, London, UK.

Kertesz M. (2016) Pers comm. Bacteria in spawn rum compost.

Ormsby, M. (2016) Import Risk Analysis: Phytosanitary Risks of Importing Phase III Agaricus bisporus Mushroom Compost from Northern Europe. Ministry for Primary Industries, New Zealand.

MPI (2016a) Draft import Health Standard for Processed Animal Manure Products. December 2016. Ministry for Primary Industries, New Zealand.

MPI (2016b) Guidance Document for Processed Animal Manure Products. December 2016. Ministry for Primary Industries, New Zealand.

MPI (2016c) Rapid Risk Assessment: Mushroom substrate containing horse and poultry manure. Version 2.0, December 2016. Ministry for Primary Industries, New Zealand.

MPI (2016d) Risk Management Proposal for New Import Health Standard (IHS) for Phase 3 Mushroom Growing Medium. December 2016. Ministry for Primary Industries, New Zealand.

MPI (2016e) Risk Management Proposal for Processed Animal Manure Products. December 2016. Ministry for Primary Industries, New Zealand.

Van der Klei, G. (2016) Temperatures of meadow mushrooms, phase one, compost bunker. Plant and Food Research, Christchurch, New Zealand. See Appendix 2.

Appendix 1

Plant and Food Research report - Temperatures of meadow mushrooms phase one compost bunker

PFR SPTS No. 13965

Temperatures of meadow mushrooms, phase one, compost bunker

van der Klei G

November 2016

Confidential report for:
Meadow Mushrooms Ltd

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CONTENTS

EXECUTIVE SUMMARY

Temperatures of meadow mushrooms, phase one, compost bunker

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November 2016

Meadow Mushrooms Ltd use Phase One composting bunkers to create a substrate for growing their mushrooms. This report will summarise temperature patterns spatially at the front of the compost pile and temporally at the core of the compost.

Temperatures were measured using two methods. Firstly, Meadow Mushrooms have multiple probes within each bunker that record temperature near the centre of the compost piles. They have provided 28 days of data from five bunkers which give a temporal perspective of compost temperatures. Secondly, a probe constructed by Plant & Food Research was used to measure spatial variation in compost temperatures at the front of the compost pile.

Temporal changes in temperature at the core of the compost pile were assessed against three thresholds with the following results:

1. Temperatures at the core of the compost pile consistently exceeded 65°C for 8 h.
2. Temperatures did not regularly exceed 80°C for 22.7 h (1364 min) within a given phase of the composting process.
3. It would be rare that the compost pile would exceed 80°C for a duration of 24 h twice within a single batch of compost as it moves through the four composting phases.

At the front of the compost p le temperatures were generally cooler nearer the surface of the pile. Similarly, the compost was cooler near the bunker floor where air is forced into the pile. The data suggest that in these areas it is likely a proportion of the compost will not exceed 65°C for any extended periods. It also suggests that even within warmer areas of the compost there is variation in temperatures and colder pockets exist. Consequently, mixing of the compost is an important process to ensure that all compost within a cool zone will at some stage move into the warmer centre of the pile; it is unlikely that 100% of the compost will experience the hot core temperatures with just one mixing. The more times the compost is mixed, the more likely it is hat all compost will at some stage move into the hotter core.

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1 INTRODUCTION

Meadow Mushrooms Limited make their own compost in Phase One bunkers (8 m wide, 40 m long and 7.4 m high, enclosed concrete construction). Air is forced up through the bottom of the bunker to assist in keeping the compost pile aerobic. The compost is a mix of straw, gypsum and chicken manure, and is mixed three times during the composting process. This compost later provides a substrate for growing their mushrooms.

Meadow Mushrooms has requested technical services aimed at describing the spatial and temporal changes in temperature within a phase one composting bunker. Their specific focus is the cold zones of the compost pile.

This report has been divided into four sections: introduction, methodology, results and summary. Within each of the methodology and results sections multiple questions have been addressed. These questions have been answered using a combination of data provided by Meadow Mushrooms, and data measured using a probe designed and constructed by Plant & Food Research.

An important aspect that this work does not cover is the movement of compost with each transfer. To ultimately answer the question of what the maximum temperature any given compost particle reaches and for how long it reaches that temperature, we need to know what the probability of compost moving from a cold to a hot zone is with each transfer. This is outside of the scope of this proposal and would be a complex piece of work.

2 METHODOLOGY

Three different methods have been used to analyse the data; these are explained further in later sections.

- Meadow Mushrooms have provided 28 days of temperature data from five bunkers. Temperatures are measured near the core of the compost piles. This will be used to interpret the temporal changes in temperature within and between phases.
- A probe constructed by Plant & Food Research that measures temperature at eight points along its 1.55 m length was used to assess spatial variation. This is primarily used to measure temperatures across the face of the compost to a horizontal depth of 1.55 m.
- The Meadow Mushroom probes were also used to measure the change in emperature with vertical depth. They were inserted ca. 1.8 m into the compost and then pulled out at 0.3 m increments. The temperature was measured at each depth

2.1 Examination of existing data from Meadow Mushroom probes

Twenty-eight days of temperature data collected at 5-min intervals was provided by Meadow Mushrooms for each of their five compost bunkers.

Within each bunker there are four temperature probes. These probes are centralised along the length of the 40 m bunker with 8 m spacing between them. They are pushed down into the compost through holes in the ceiling, and the measurement tip sits 2.1 m above the floor of the bunker. Once a bunker is loaded the probes are inserted and removed again before the compost is unloaded. During the first half of the composting phase (Bale break, and Transfer 1), all four probes are inserted. In the latter half (Transfer 2 and Transfer 3), only two probes are put in place because as the compost breaks down and there is insufficient volume for a continuous pile so two piles form. The fixed positions of the 2nd and 4th probes means they do not enter the compost pile at all in these latter phases.

There are four main phases within the Phase One bunker composting process: Bale Break, Transfer 1, Transfer 2 and Transfer 3. The first phase is Bale Break, and contains the freshly broken straw bales mixed with chicken manure and gypsum. At the end of the Bale Break phase, the compost is removed from the bunker, mixed, and returned to a different bunker. This second phase is called Transfer 1. The compost is removed and mixed two more times, constituting Transfer 2 and Transfer 3. The compost is destined for two different systems: Shelf and Tray. Shelf and Tray compost have slightly different proportions of straw, gypsum and manure. Thus, this work has focused on the following 8 phases: Shelf Bale Break, Shelf Transfer 1, Shelf Transfer 2, Shelf Transfer 3, Tray Bale Break, Tray Transfer 1, Tray Transfer 2, and Tray Transfer 3.

The large data set provided by Meadow Mushrooms was split into 35 cycles. A cycle spanned from the time the probes were inserted into the compost through to their removal. Following loading of a bunker, temperatures within the compost increased rapidly. After the initial increase, one of three scenarios occurred: temperatures plateaued and stayed relatively stable (Figure 1.a), temperatures plateaued initially but fluctuated to the end of the cycle (Figure 1.b), or temperatures continued to increase (Figure 1.c).

Cycles were broken down into stabilised cycles. A stabilised cycle is a subset of the cycle data, and spans from the time temperatures plateau (time of stabilisation) until the end of the cycle. The time of stabilisation was selected from visual assessment of the data.

Temperatures were corrected using certified calibrations provided by Meadow Mushrooms; calibrations were based on tests done on the 1 July 2016.

Any temperature probes that were not working properly over the duration of a cycle or stabilised cycle were excluded from all calculations.

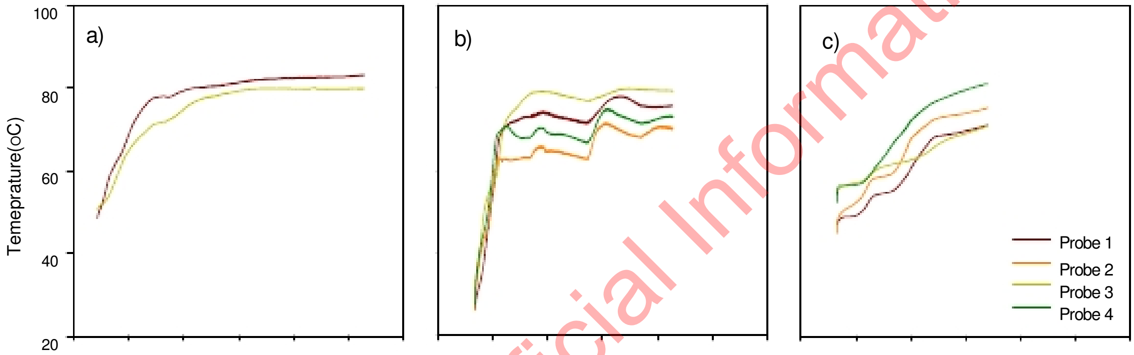

Figure 1. Temperatures in compost bunkers (°C). Each figure shows a single cycle from one of three scenarios: a) Temperatures stabilise and stay constant, b) temperatures initially stabilise but vary throughout the remainder of the phase, and c) temperatures continue to increase over the duration of the phase.

2.1.1 Temperature gradients along the bunkers

Meadow Mushrooms temperature data was analysed using REML analysis to determine if there were significant differences in temperature along the length of the compost bunker by comparing the data from each of the four probes in all five bunkers. The entire data set was considered, as well as just the temperatures during the stabilised cycle.

2.1.2 Time taken for temperatures to stabilise

The total number of hours within each cycle is calculated and summarised by phase. Only complete cycles, and cycles in which temperatures plateaued (e.g. Figure 1.a and 1.b) were included in these calculations; a total of 27 cycles was considered.

Time to stabilisation was calculated as the hours from the start of a cycle until temperatures plateaued. Only cycles that fell under the scenarios depicted in Figure 1.a and Figure 1.b were included, and only if the data was complete enough to show the start and plateau point of the cycle. This resulted in 29 cycles being considered.

2.1.3 Differences in average temperatures between transfers

An average temperature during the stabilised cycle has been calculated and summarised for each phase. Twenty-nine cycles are included in these calculations.

2.1.4 Maximum temperatures

The single highest temperature recorded for each phase is reported. The maximum temperatures from each probe within each cycle have also been calculated and averaged by phase.

2.1.5 Threshold temperatures and time

Time of exposure to high temperatures in the pile is important to kill off pathogens. In our interpretation we consider three thresholds and identify whether these conditions are meet within each phase.

1. A minimum of 65°C for 8 h
2. A minimum of 80°C for 1364 min (22.73 h)
3. A minimum of 80°C for 24 h.

The first threshold was suggested in a document released by the Ministry of Primary Industries (MPI) to be an available management option for the control of both Mushroom Virus X (MVX) and *Trichoderma aggressivum* (MPI Plant and Pathways Team 2015). Although to date neither the virus nor fungus have been identif ed in New Zealand, Meadow Mushrooms wish to see if their current composting processes are sufficient for their management as both would pose risks to their current practises.

The second threshold was included as it has previously been reported to be sufficient to remove any hazards from poul ry products (MPI 2016). MPI's Rapid Risk Assessment: Mushroom substrate containing horse manure and poultry manure document, assesses a range of equine pathogens and concludes they provide no risk if this temperature threshold is met. Both poultry and horse manure are commonly used components of mushroom composts.

Finally, the third threshold is considered as these conditions are reportedly met within a single phase of the mushroom substrate production process (compost) by a company using similar composting practices to Meadow Mushrooms (MPI 2016). Further, their production process has only two phases, and they report that this threshold is met within both phases. Meadow Mushrooms wishes to see if the temperatures reached during their own composting process also meet this threshold.

We have analysed the data in two ways. Firstly, a cycle has been considered to meet the threshold if at least one of the probes within that cycle meets the specified criteria for time and temperature. Secondly, individual probes are analysed to see if they meet the criteria. These findings have been summarised by phase.

This work also traces six batches of compost from the start of the composting process, through Bale Break, Transfer 1, Transfer 2 and Transfer 3, and reports whether it is likely to have exceeded 80˚C for 24 h in two or more phases.

2.2 Temperatures measured using Plant & Food Research probe

A temperature probe constructed by Plant & Food Research was used for this work and will be referred to as the PFR Probe (Figure 2). Continuous temperature measurements are made at eight positions along the probe using Type T thermocouple wired to a Campbell science AM25/T and logged on a Campbell Science CR1000 data logger. The eight measurement points were positioned so that temperatures were recorded at the following depths into the compost pile: 0.05, 0.2, 0.35, 0.5, 0.65, 0.95, 1.25, and 1.55 m. The probe was left in each position within the compost for ca. 10 min or until temperatures did not change.

This work was carried out on the afternoon of 15 September 2016 in Bunker 3, which contained a Tray Transfer 2 compost. The compost had been transferred into the bunker the previous morning, and was due for its next transfer the following morning.

Figure 2. PFR Probe. Temperatures are measured at 8 points along the probe with Type T Thermocouples. Thermocouples are wired into a Campbell Scientific AM25T and recorded on a Campbell Scientific CR1000 Datalogger.

2.2.1 Probe calibration

The PFR Probe was calibrated with a certified Cole Palmer Thermometer (Model: 90205-26). The PFR probe read 48.9 and 79.0°C in a water bath of 49.9 and 80.3°C, respectively. As the thermocouples all read within 0.13°C of each other a single calibration was used across all eight positions.

2.2.2 Temperatures at the face of the compost pile

Temperatures at the face of the compost pile were measured at 16 locations in a 4 x 4 grid pattern using the PFR Probe (Figure 3). The grid extends 4 m into the bunker from the left hand side wall to the centre point of the 8 m wide bunker. It is assumed temperatures on the right hand side of the bunker behave similarly to the left hand side. The probes were pushed into the compost at each of these locations and temperatures recorded at eight points along the length of the probe. Measurements made on this plane are referred to as the horizontal depth.

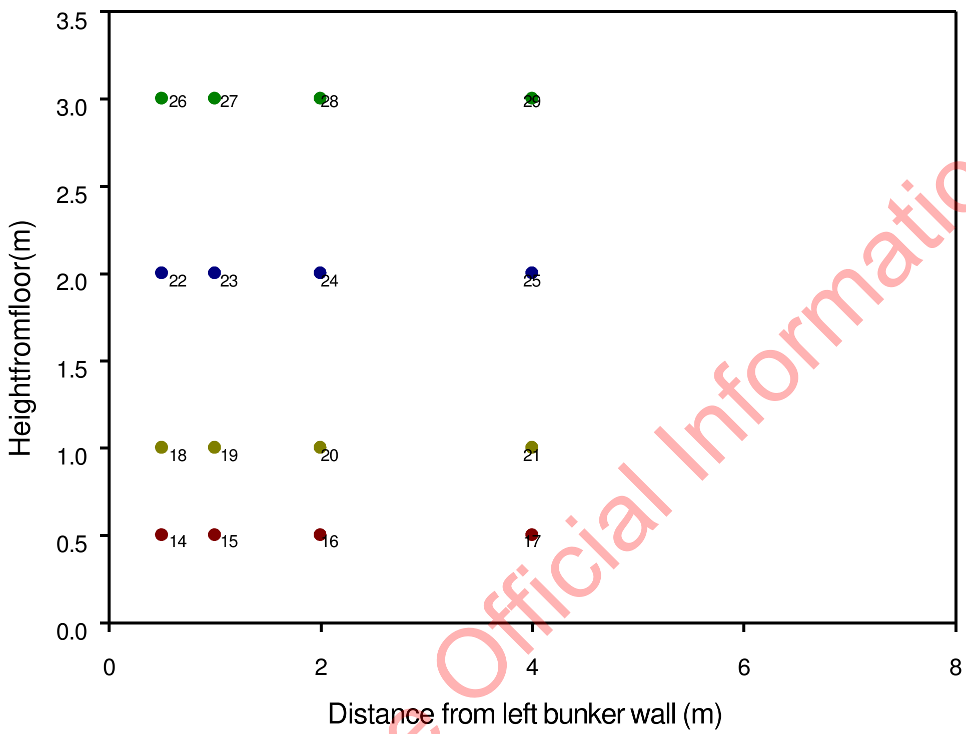

Figure 3. Positions on compost face where temperatures were measured. Each position has been given a position ID as specified by the label shown to the right of each symbol. Data are grouped by height from floor as depicted by each of the four symbol colours.

2.2.3 Changes in temperature with vertical depth

Changes in temperature with increasing depth into the compost were made from the top of the pile using Meadow Mushroom probes 1 and 3, and at two positions with the PFR Probe (Figure 4). Measurements on this plane will be referred to as vertical depth.

The Meadow Mushrooms probes 1 and 3 were inserted fully into the compost pile, with the measuring tip 2.1 m off the floor. They were then pulled up at 30 cm increments and held in this position until the temperature reading stabilised. The height of the compost at the position of the Meadow Mushroom probes was measured as accurately as possible. This value was used to calculate the depth into the compost that each measurement was made. The depths of measurements are reported in Table 1.

Due to health and safety concerns limiting our access to the bunkers our ability to accurately measure the height of the compost where each of the Meadow Mushroom probes were positioned was compromised. However, we are confident that the depths reported in Table 1 are within plus or minus 10 cm of their true depth.

Table 1. Depth (cm into compost pile) of temperatures measurements using Meadow Mushrooms probes 1 and 3.

	Depth of measurement (cm)	
Depth ID	MM Probe 1	MM Probe 3
1	*	10
2	30	40
3	60	70
4	90	100
5	120	130
6	150	160
7	180	190

Measurements of the vertical change in temperature were also made at two locations using the PFR Probe. The position of these measurements, and those of the Meadow Mushroom compost is illustrated in Figure 1. Both positions measured using the PFR Probe were 1.5 m back from the face of the compost pile: Position 1 was 4 m from each wall, and Position 3 was 0.5 m from the left-hand wall.

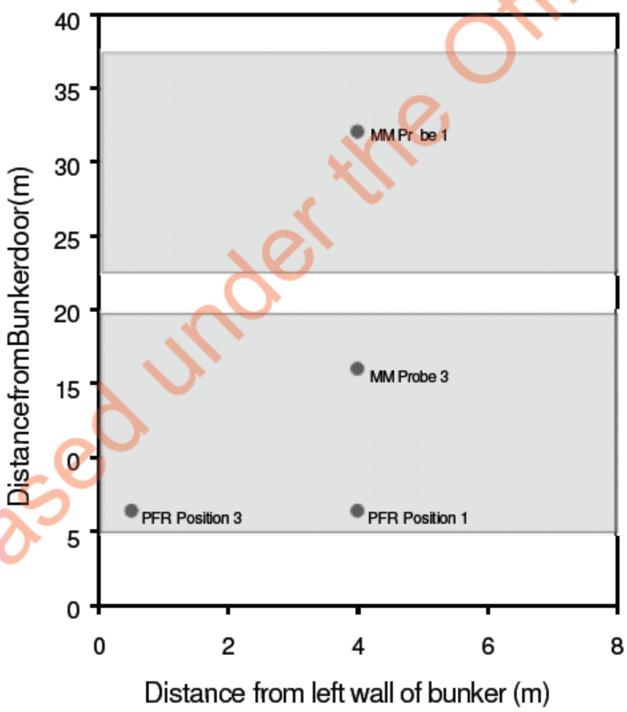

Figure 4. Plan view of the compost bunker showing the position of each of the probes where vertical measurements were made. The grey shading indicates the approximate position of the two compost piles within the bunker. Labels show the position IDs referred to in the text.

2.2.4 Comparison of temperatures on the horizontal and vertical planes

Measurements of the vertical change in temperature (Section 2.2.3) are compared with the horizontal changes in temperature at the face of the compost pile (Section 2.2.2). This work looks at the comparability of the two areas of the compost pile.

3 RESULTS

3.1 Examination of existing data from Meadow Mushroom probes

3.1.1 Temperature gradients along the bunkers

Temperatures varied significantly along the length of the bunker, whether all data was considered or the stabilised temperatures alone (*P* < 0.001 in both cases). However, the differences in temperature were minor for practical purposes, not exceeding 3.75°C, so are not of concern for this work (Figure 5).

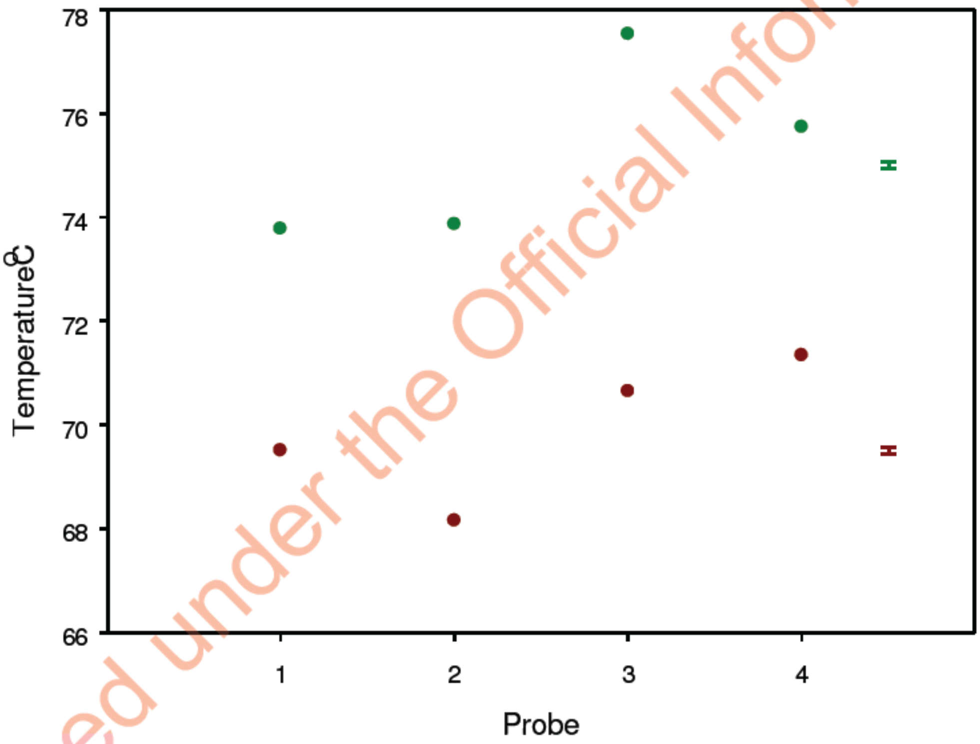

Figure 5. Mean temperatures of Meadow Mushroom probes. Green circles donate the average temperature of the stabilised cycle for each probe and red circles donate the overall average temperature. Error bars represent LSDs. Probe 1 is closest to the back of the bunker, and Probe 4 closest to the door.

3.1.2 Time taken for temperatures to stabilise

Table 2 shows the average length of each phase and the average time taken for temperatures to stabilise. By Transfer 3 it took about twice as long for the temperatures to stabilise than in earlier phases. The total time that the compost stays in the bunker during Transfer 3 is also about twice that of the other transfers.

Table 2. Average number of hours in a given phase and average number of hours taken for temperatures to stabilise within that phase.

Phase		Hours in phase (range of hours)	Hours until stabilising (range of hours)
Shelf	Bale Break	49 (47–51)	34 (24–45)
	Transfer 1	65 (63–66)	28 (18–51)
	Transfer 2	54 (34–65)	29 (9–46)
	Transfer 3	115 (110–116)	67 (33–107)
Tray	Bale Break	87 (81–93)	32 (11–51)
	Transfer 1	47 (43–49)	23 (10–45)
	Transfer 2	41 (38–45)	26 (13–38)
	Transfer 3	159 (159–161)	55 (26–82)

3.1.3 Differences in average temperatures between transfers

Average temperatures were generally lower and varied more between cycles in tray composts than in shelves (Table 4).

Table 3. Average temperature (°C) during stabilised phase of cycle.

Phase		Temperature (°C)	Standard deviation
Shelf	Bale Break	80.0	1.1
	Transfer 1	76.0	1.3
	Transfer 2	78.2	1.8
	Transfer 3	80.5	0.5
Tray	Bale Break	76.1	3.7
	Transfer 1	77.9	2.2
	Transfer 2	74.8	3.1
	Transfer 3	73.6	5.0

3.1.4 Maximum temperatures

Maximum temperatures are presented in Table 4. These are the single highest temperatures recorded for each phase. The 'average of maximum temperatures' is also reported. This is the maximum temperature from all probes within a cycle averaged by phase.

The maximum temperature reached in any bunker was 85.9°C, occurring in a Shelf Transfer 1; the lowest maximum temperature was 78.6°C recorded in a Tray Transfer 3. The Tray Transfer 3 phase is unique as 46% of the time the bunker is only half full. This is due to the Phase II tray facility requiring deliveries to be split over the week. Thus, 4 days after a Tray Transfer 3 is filled the first half of the compost is removed, with the remainder removed 3 days later. With the exclusion of Tray 3 from the calculations there is very little variation in the maximum temperatures; the mean is 81.7°C and standard deviation 1.03.

Table 4. Maximum temperature recorded and the average maximum of all probes within a given phase.

Phase		Maximum temperature (°C)	Average of maximum temperatures (°C)
Shelf	Bale Break	83.6	80.8
	Transfer 1	85.9	77.4
	Transfer 2	80.8	78.5
	Transfer 3	83.2	80.9
Tray	Bale Break	83.1	78.7
	Transfer 1	83.5	79.7
	Transfer 2	85.5	78.2
	Transfer 3	78.6	75.0

3.1.5 Threshold temperatures and time

Every cycle and every individual probe satisfied the first threshold of 65°C for 8 h. This indicates that the temperatures *in the core* of the compost are sufficient to control MVX and *T. aggressivum* according to MPI's recommendations (2015).

By contrast, the threshold of 80°C for 1364 min (22.73 h) was rarely met by all probes within a phase (Table 5). Table 6 presents the average number of hours that 80°C is exceeded during each phase. It suggests it takes the first three phases for Tray compost to exceed 1364 min at 80°C; temperatures do not exceed 80°C in the final tray phase. In contrast, this condition may be meet in Shelf compost within Transfer 3 alone. However, it must be noted that only 38% of probes that were in Transfer 3 phases ever meet this threshold. Therefore, it seems unlikely that all of the compost in the core or the pile regularly exceeds 80°C for more than 1364 min even across all four phases of the composting process.

Threshold three requires the compost to exceed 80°C for a minimum of 24 h within a given cycle. Results are presented in Table 5, and do not vary much from Threshold 2. However, we must consider the chance of this threshold being met across two or more of the phases. Even when considering cycles to have met the threshold if only one of the probes meets the parameters, there are still cycles that did not reach 80℃ for 24 h. Therefore, we cannot with certainty conclude that the compost reaches 80℃ for 24 h in multiple phases.

In support of these findings, we have tracked six batches of compost through all four phases of the composting process (3x Shelf and 3x Tray composts). There were no batches in which all probes exceed 80℃ for 24 h within a single phase. If we are to consider the threshold met if only one probe within a cycle reaches 80℃ for 24 h, then only one batch exceeded the threshold during more than one phase.

Table 5. Percentage of cycles in which at least one probes meet the threshold, and the percentage of individual probes that meet the conditions for each phase. Two conditions specified: Threshold 2, minimum of 80℃ for 1364 min (22.73 h), and Threshold 3, minimum of 80℃ for 24 h.

Phase		Threshold 2: Minimum of 80℃ for 1364 min or more		Threshold 3: Minimum of 80℃ for 24 h or more	
		% of cycles that meet the condition	% of probes that meet the condition	% of cycles that meet the condition	% of probes that meet the condition
Shelf	Bale Break	50%	38%	50%	25%
	Transfer 1	33%	8%	33%	8%
	Transfer 2	0%	0%	0%	0%
	Transfer 3	75%	38%	75%	38%
Tray	Bale Break	50%	25%	50%	25%
	Transfer 1	0%	0%	0%	0%
	Transfer 2	0%	0%	0%	0%
	Transfer 3	0%	0%	0%	0%

Table 6. Average number of hours that compost is at a minimum of 80℃.

Phase		Hours compost is at a minimum 80℃
Shelf	Bale Break	11.8
	Transfer 1	4.9
	Transfer 2	3.7
	Transfer 3	24.6
Tray	Bale Break	13.0
	Transfer 1	7.5
	Transfer 2	4.2
	Transfer 3	0.0

3.2 Temperatures measured using Plant & Food Research probe

3.2.1 Probe calibration

The PFR Probe was considered accurate enough for this work, and the maximum 0.13°C variation between each of the eight measurement points acceptable.

3.2.2 Temperatures at the face of the compost pile

Figure 6 shows a cross section of the face of the compost pile and the temperatures recorded at each position on the grid pattern. The figure depicts the left hand side of the bunker, and represents a single point in time only, 20 h into a 38-h Tray Transfer 2 cycle

To aid in interpretation of the data, three zones have been defined from the temperatures measured with the PFR Probe and their attributes are presented in Table 7. The temperature ranges presented for each zone are approximate; the temperatures within the compost were relatively variable resulting in temperatures representative of one zone overlapping that of another zone (Table 7). Note, the volumes of compost that fa ls within each zone is calculated for the front 1.5 m of the compost pile only (Table 7).

A cool zone at the base of the compost pile reduces with increasing horizontal depth into the pile. This zone extends from the floor to between 0.5 and 1 m high, and extends furthest into the compost pile next to the wall. At shallow horizontal depths, this zone also extends a short way up the left hand wall.

The medium temperature zone extends from the cold zone to 1.55 m horizontal depth at 0.5 m height. It also encompasses all of the compost from 0.05 m to between 0.2 and 0.35 m across the rest of the face of the compost.

Finally, the hot zone extends from between 0.2 and 0.35 m horizontal depth to 1.55 m into the compost pile at heights of 1, 2 and 3 m above ground, with the exception of the position closest to the wall at 1 m height which remains primarily in the medium temperature zone.

The cooler zone at the base of the compost pile may be explained by two factors. The concrete floor itself w ll, at least at the beginning of phase, be endothermic, drawing heat from the compost Secondly, and more importantly, air is blown into the compost pile from the floor to p event the compost pile becoming anaerobic. As the air is much cooler than the bulk of the compost it is likely responsible for lowering the temperature near the bunker floor. The height of this cool zone reduces with increasing horizontal depth into the pile.

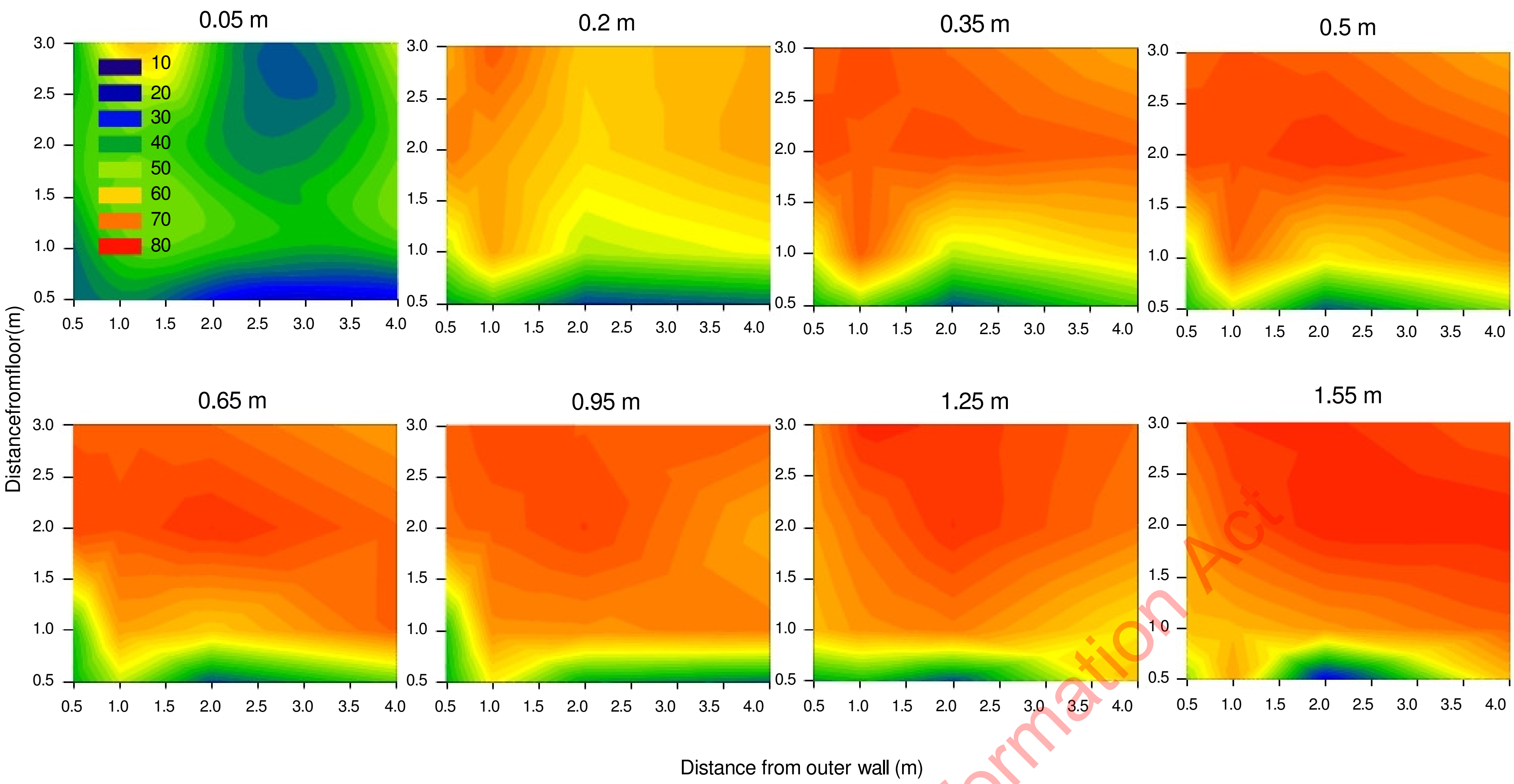

Figure 6. Cross sections of the compost pile showing temperatures (℃) at each of the eight horizontal depths measured.

Table 7. The average and range of temperatures for each of the areas defined cool, medium and hot zones. Also presented is the percentage of positions within each areas that temperatures fall outside of the defined temperature range. An estimated volume of compost in the front 1.55 m of the compost is also reported for each zone.

Zone	Average Temperature (°C)	Temperature Range (°C)	%of positions that temperature falls in a different zone	Estimated volume (m³)	% of volume
Cool	36.2	<40	19%	3.6	8%
Medium	50.7	40–70	16% cooler 8% hotter	18.2	39%
Hot	70.9	>65	14%	25.1	54%

If temperatures do not rise into the Hyperthermophilic range for extended periods of time there remains opportunity for the survival of some thermophiles such as *T aggressivum*. At both 2 and 3 m above ground level, these temperatures are generally achieved within 0.35 m of the compost face. However, it is not until 0.95 m horizontal depth that hree of four positions reach hypothermophilic conditions 1 m high off the floor, and they are not met at all 0.5 m above the floor.

It is important to remember that this set of measurements is at a single time point. It does not inform us how long these temperatures are achieved.

Table 8. Temperature range (°C) that different microorganisms groups survive and function in.

Micro-organism groups	Temperature ranges for growth (°C)
Mesophiles	24 to 45
Thermophiles	45 to 70
Hyperthermophiles	70 to ca. 120

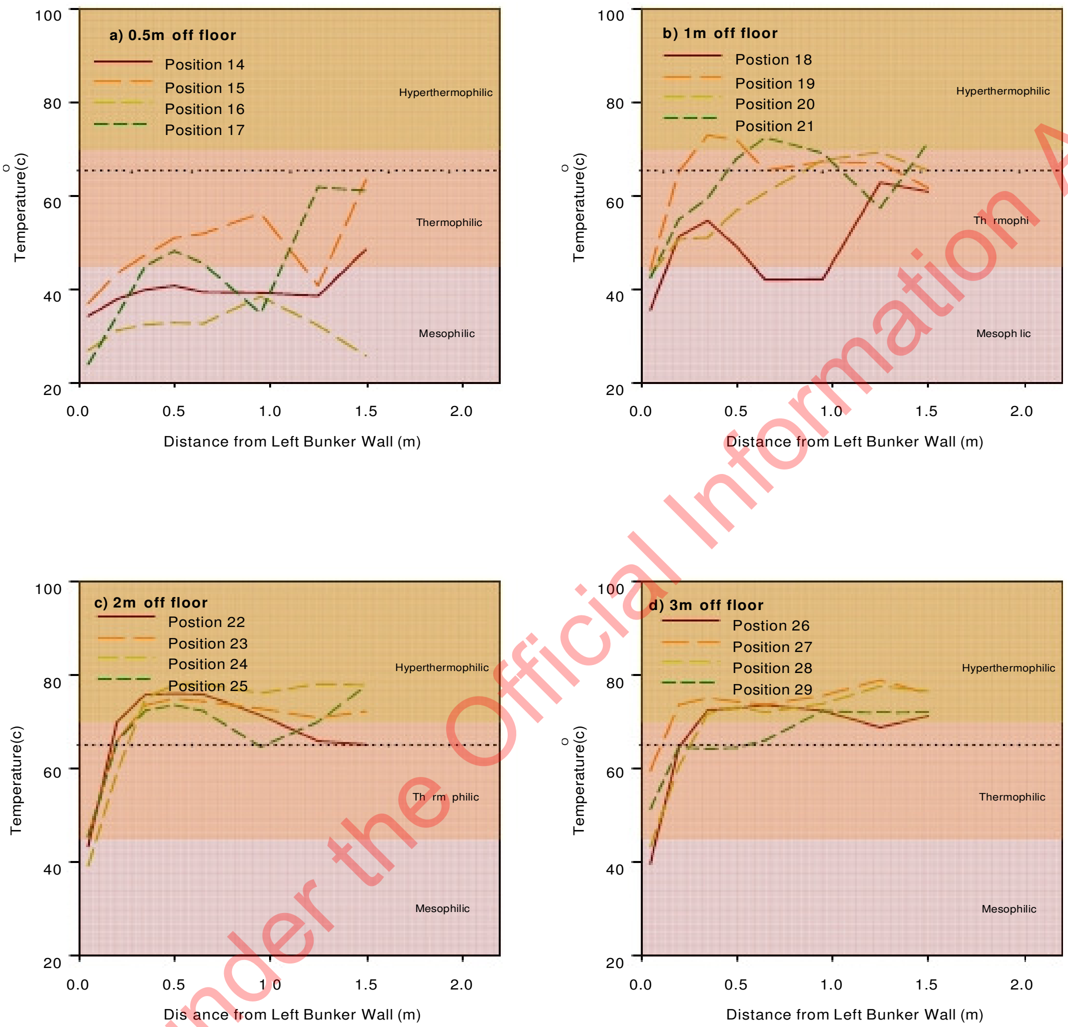

Figure 7. Temperatures measured at eight depths to 1.55 m horizontal deep within the compost pile. Measurements are grouped by the height at which they were made (a) 0.5 m from floor, (b) 1 m from floor, (c) 2 m from floor and (d) 3 m from floor. The different background colours show the various temperatures at which different microorganism groups survive and function, and the dashed lined at 65℃ represents the temperatures assessed for threshold 1 (Section 3.1 5).

At three of the four heights that temperatures were recorded there seems to be no trend of increasing temperatures as the sample position moves away from the left hand wall. However, this is not true at 1 m above ground level (Figure 7). At this height all probes end up at ca. 60℃ by 1.55 m deep; however, this temperature is reached 0.2 m into the compost at 4 m from the wall, compared with 1.25 m into the compost at 0.5 m from the wall. This suggests some cooling effect of the wall at this height.

The overall higher temperatures at 2 and 3 m above ground level may be a response to the dimensions of the front of the compost pile. In viewing the compost pile, there appears to be a ‘break line’ at approximately 1.8 m high (Figure 8). Above this point the face of the compost pile is relatively vertical, and the compost is dense (Figure 9). Below this point, the compost is loose and sloping. It appears that this compost has broken off the top face of the compost pile during or after its construction. It is suggested that the below the break line the more loosely packed compost, and greater surface area, contribute to the lower temperatures observed in the measurements at 0.5 and 1 m above ground level.

Figure 8. Photograph of the front of the compost pile when grid sampling was carried out. The dashed line depicts the 'break line' as described in the text. The red circle highlights the PFR probe shown in position 25 (2 m high and 2 m in from the left wall).

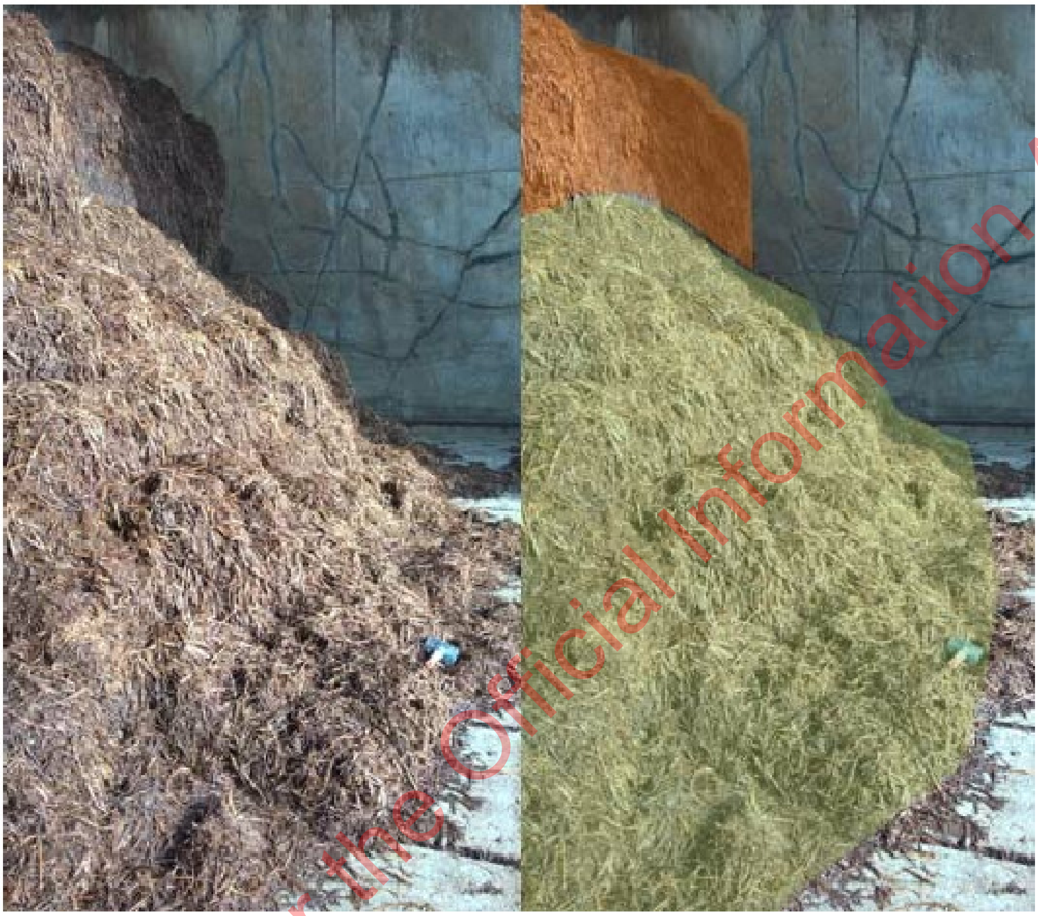

Figure 9 Photograph of the face of the compost pile at the time of grid sampling. The pictures are identical, with the right side overlaid with orange to indicate the dense vertical face, and with green to indicate the loose compost which has fallen from face above.

As previously mentioned this work was done 20 h into a 38-h Tray transfer 2 cycle. The temperatures measured by the Meadow Mushroom probes during this cycle are shown in Figure 10a. Also shown are the temperatures at position 25 (Figure 3) following the sampling of the grid pattern through to the end of the cycle (Figure 10b). Temperatures had stabilised in one of the two Meadow Mushroom probes at the time this work was done. The temperature at position 25 continued to increases at all eight horizontal depths following this work, except at 1.55 m. However, even with this increases in temperature some important thresholds were not crossed. A temperature of 80℃ was not exceeded at any depth by either the Meadow Mushroom probes or the PFR probes. Further, although the temperatures at 0.05 m are increasing they did not exceed 65℃ by the end of the cycle. We suggest that similar increases in temperature may have occurred at other positions in the face in the compost, particularly those 2 m or higher. However, it seems likely that the temperatures 0.5 m above the bunker floor would not experience the same level of increase as the cold air pumping into the bottom of the compost pile likely prevents this.

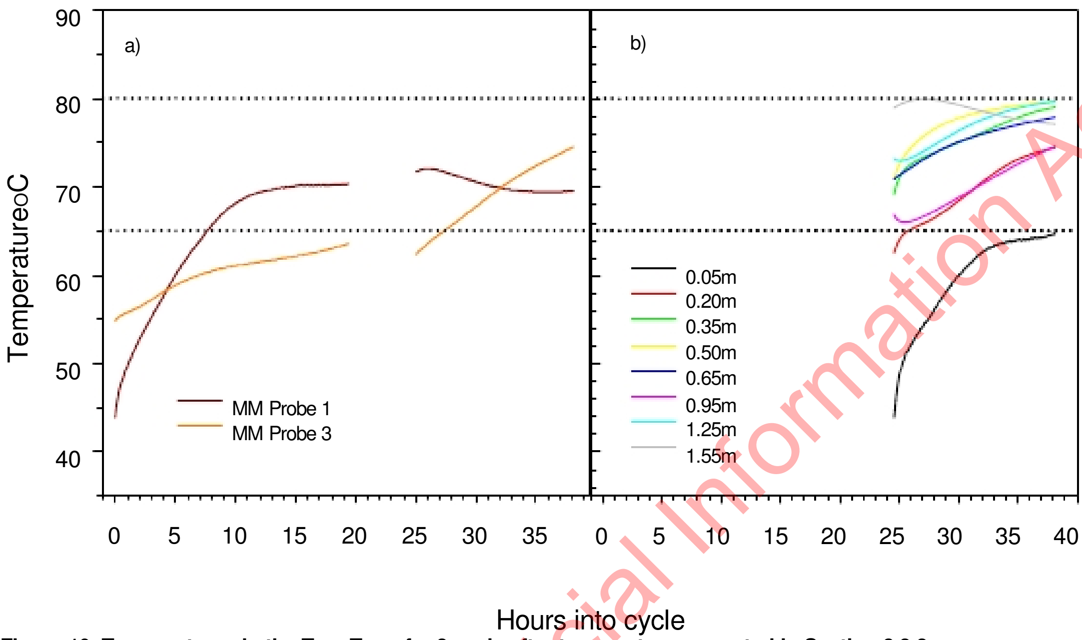

Figure 10. Temperatures in the Tray Transfer 2 cycle after temperatures reported in Section 3.2.2 were completed. a) Temperatures measured by Meadow mushroom probes, the gap in the data is during the time probes were being lifted to measure vertical temperature gradients, b) temperature at eight horizontal depths measured with the PFR probe when left 2 m above ground level and 4 m in from the bunker wall. Dashed lines at 65°C and 80°C represents thresholds investigated in earlier sections.

3.2.3 Changes in temperature with vertical depth

All four probes recorded similar temperatures in the outer 0.1 m of the compost pile, with an average temperature of 45.4°C (Figure 10). The temperature increased rapidly with increasing vertical depth into the compost pile. Temperature responses varied between vertical depths and positions. The MM Probe 1 and PFR Position 3 show close agreement across all vertical depths, temperatures becoming relatively stable approximately 0.5 m into the compost pile. Although PFR Position 1 shows the same initial increase in temperature, temperatures do not continue to increase at the same rate as MM Probe 1 and PFR Position 3, but do reach the same temperatures by 0.95 m. Similarly, temperature at MM Probe 3 did not increase beyond 0.4 m vertical depth.

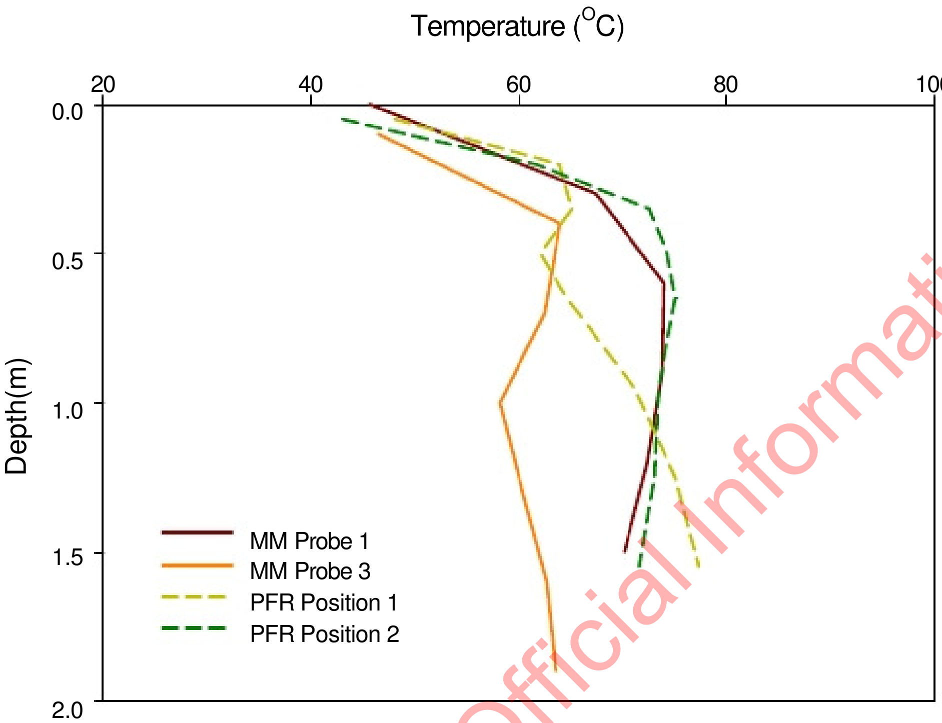

Figure 11. Vertical change in temperature (℃) at four positions in the bunker measured by Meadow Mushroom and PFR Probes.

3.2.4 Comparison of temperatures on the horizontal and vertical planes

There is little difference in the temperature gradient into the compost pile vertically or horizontally at 2 and 3 m height (Figure 12). However, temperatures at 1 m height averaged across all horizontal depths were 9.4℃ lower than those measured vertically and at 2 and 3 m above ground level. At 0.5 m height this difference is even larger, with temperatures averaging 26.9℃ lower than the vertical and 2 and 3 m gradients. This difference illustrates that across all horizontal depths compost temperatures are cooler nearer the floor of the bunker.

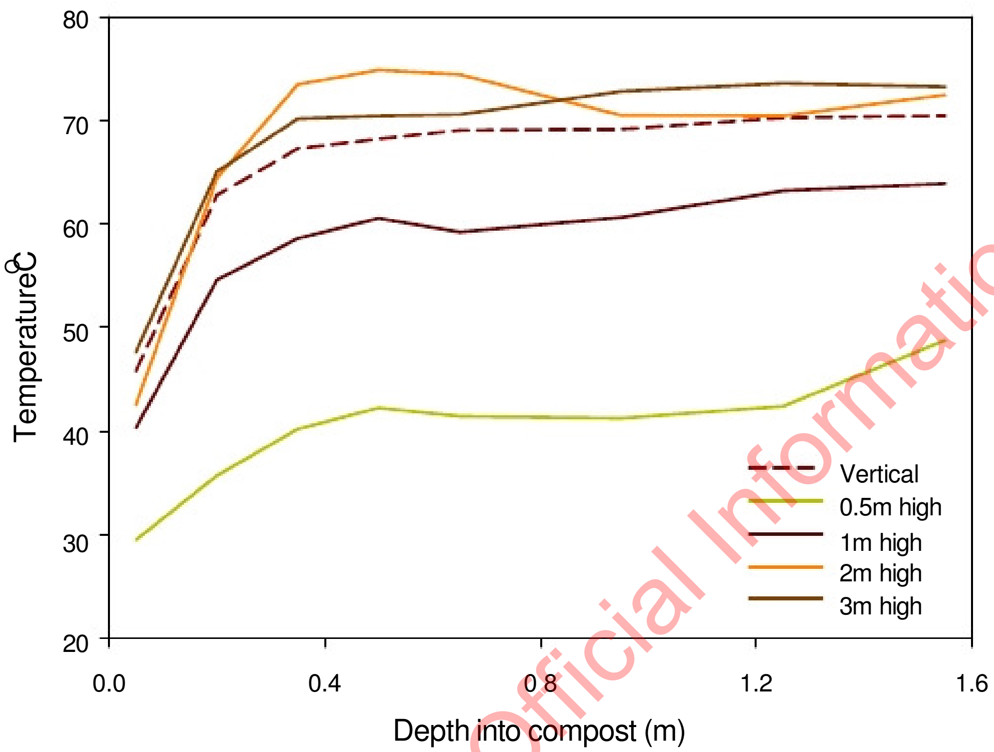

Figure 12. Comparison of the temperature gradient measured vertically into the top of the compost pile, and horizontally 0.5, 1, 2 and 3 m above the ground at the face of the compost pile.

4 SUMMARY

- It takes an average of 29 h for temperatures in the centre of the compost to stabilise during Bale Break, Transfer 1 and Transfer 2 phases. Transfer 3 takes over twice that time at 61 h.
- Tray composts average 3.1°C cooler than Shelf composts in the centre of the pile, and are cooler in all phases except Transfer 1.
- The average maximum temperatures for each cycle, as measured in the centre of the compost by Meadow Mushrooms probes, exceeded 80°C in only two of the eight phases.
- Once compost temperatures have stabilised, the average temperature across all phases is 77°C.
- The compost in the centre of the pile consistently reached 65°C for 12 h.
- The compost in the centre of the pile did not regularly exceed 80°C for more than 1364 min (22.73 h), the time suggested by MPI as being sufficient to manage hazards in chicken and horse manure.
- A temperature of 80°C is not regularly achieved for 24 h within a phase, and rarely occurs multiple times within a compost traced from Bale Break to end of Transfer 3.
- The change in temperature with increasing depth into the compost is similar from the top of the compost down (vertical depth), to that at the face of the compost 2 and 3 m above the floor (horizontal depth).
- At the front of the compost pile below approximately 1.8 m, the compost is loose where it appears to have broken off the face of the pile above. This compost is cooler than the denser compost above.
- Temperature zones were defined at a single point in time: 20 h into a 38-h Tray Transfer 2. Although there were some further increases in temperatures after this time, a snapshot of the different t mperature zones is provided:
  - A cold zone is defined in which 81% of temperatures were less than 40°C. The average temperature of this zone is 36.2°C and accounts for 8% (3.6 m^3) of the volume in the front 1.55 m of the compost pile.
  - A medium zone has also been defined, in which 76% of the temperatures are between 40 and 65°C. This accounts for 39% (18.2 m^3) of the volume in the front 1.55 m of the compost pile.
  - A hot zone is defined in which 86% of temperatures exceed 65°C. At the time of measurements, the average temperature in this zone was 70.9°C and accounted for 54% (25.1 m^3) of the volume in the front 1.55 m of the compost zone.
  - This work suggest that even within the time frame of a phase the compost in the surface 0.05 m of the compost pile may not exceed 65°C.
  - The cold air being forced into the bottom of the compost pile will likely prevent temperatures in the 0.5 m of compost nearest the bunker floor from increasing beyond 80°C.
- Within the compost pile there is variability in temperatures. For example, at one position in the hot zone (where temperatures are generally >70°C) the temperature was only 50.9°C.

- In the Meadow Mushrooms composting system a loader removes compost from the front of the pile, before it is mixed, and then layered across the floor of the next bunker. It seems reasonable to assume that compost from the cold face of the pile could end up on the floor of the next compost bunker which is also a cold zone. Therefore, it is likely that with only one mixing a proportion of compost will never experience the warmer temperatures in the core of the pile. With every additional mixing the likelihood of all compost experiencing the warmer inner core temperatures would increase.
- To assess the chances of any given compost particle remaining within a cool zone or he entirety of the composting process further work is required. This would aim to trace the movement of compost particles through the entire composting process and would be a relatively complex piece of work.

5 REFERENCES

Ministry for Primary Industries*:* Plant and Pathways Team 2015. Techincal advice on:Epidemiological Information of MVX and Trichodema aggressivum. Ministry for Primary Industries.

Ministry for Primary Industries 2016. Rapid Risk Assessment: Mushroom substrate containg horse and poultry manure. Ministry for Primary Industries.

DISCOVER. INNOVATE. GROW.

Appendix 2

Plant and Food Research Report - Trichoderma and MVX in mushroom compost

PFR SPTS No. 13702

Trichoderma and MVX in mushroom compost

Bulman S

August 2016

Summary

- The Ministry for Primary Industries (New Zealand) is considering an application to import spawn run phase 3 mushroom compost sourced from The Netherlands.
- The two most problematic diseases for *Agaricus bisporus*, Mushroom Virus X (MVX) and *Trichoderma aggressivum,* are found in European countries where compost components will be sourced.
- Observations and scientific detection studies show that both pathogens sporadically occur in phase 3 compost in Europe.
- *Trichoderma aggressivum* has a high heat tolerance that exceeds the controlled temperatures applied during phase 2 composting. The non-homogenous nature of composting in yards also means that compost is colonised by surrounding mesophilic fungi such as *Trichoderma* species.
- The most important vectors for *T. aggressivum* spread are workers, machinery and small compost fragments. Haulage machinery is a potential source of new *T. aggressivum* arriving in compost yards.
- Sciarid and phorid insects are persistent compost-associated pests that have been indicated as vectors of *T. aggressivum*. They are difficult if not impossible to eliminate from compost yards.
- Small foci of *T. aggressivum* infestation can be rapidly spread through compost by bulk handing. Such infestation is infrequently visible.
- Methods for detection *T. aggressivum* have been developed but they cannot be applied to large-scale screening of bulk phase 3 compost. Detection techniques are in the context of a growing system where *T. aggressivum* is present in the wider environment; they are not tools that can provide complete certainty that compost is free of any contamination.
- The biology of MVX is poorly understood. Detection techniques for MVX have also been developed but they are more expensive than those for *T. aggressivum* and suffer from the same problems of coverage in bulk systems.

Pathology of cultivated mushrooms

Under modern cultivation conditions *Agaricus bisporus* is attacked by a relatively limited group of pests and pathogens that are widely distributed around the world. In most of these cases, good farm hygiene and growth practices limit the losses that these cause on farm. Internationally, the two most problematic diseases for *A. bisporus* are Mushroom Virus X (MVX) and *Trichoderma aggressivum*. Both can cause severe losses in mushroom crops but neither has been recorded in New Zealand.

Trichoderma aggressivum - background and distribution

Compost Green Mould Disease is caused by *Trichoderma* colonisation of mushroom growth substrate (Samuels et al. 2002). The most important form of this disease is caused by *Trichoderma aggressivum,* which can cause severe or complete crop loss. This species was first identified in Ireland in the 1980s and has since occurred throughout Europe (Mamoun et al. 2000; Baars et al. 2011; O'Brien et al. 2016), the Americas and South Africa. It has not been reported from New Zealand. There are two subspecies, *T. aggressivum* f. *europaeum* and *T. aggressivum* f. *aggressivum* found in Europe and North America respectively (Seaby 1987; Chen et al. 1999). *Trichoderma aggressivum* was first reported in The Netherlands in 2006 (Lemmers 2010).

The risk of *T. aggressivum* occurrence in bulk compost

The transition to bulk production of mushroom compost has reduced the occurrence of *T. aggressivum* problems on farms (Lemmers 2010). Nevertheless, there are continuing problems with outbreaks in Europe where this fungus has been reported from phase 3 compost. Notably, from 2006 there have been reports of *T. aggressivum* in such compost in The Netherlands (Lemmers 2010; Baars et al. 2011). Testament to the continuing occurrence of *T. aggressivum* in phase 3 European compost are the significant research programmes that have investigated this issue (Lane 2010; Baars et al. 2011; Grogan et al. 2011, Lane & Cole 2013) (http://www.mushtv.eu/). In The Netherlands, *T. aggressivum* infection was thought to occur very early, probably in the compost yard (Baars et al. 2011). Although *T. aggressivum* occurs sporadically in phase 3 compost, there is incomplete understanding of the epidemiology of disease arrival and persistence in bulk systems (Lemmers 2010; O'Brien et al. 2016). Infection of Phase 3 compost with as little as 0.01% *Trichoderma*-infected compost caused up to 50% yield loss (Fleming-Archibald et al. 2016). Bulk handling of compost has been shown to spread small foci of infection more widely through final compost (O'Brien et al. 2016), showing that localized pockets of infected substrate can be diluted throughout otherwise uninfected phase 3 substrate during bulk handling. There may be no overt signs of *T. aggressivum* at phase 3 tunnel emptying (Kilpatrick et al. 2015). The source of *T. aggressivum* in phase 3 compost is not always certain, but there are a number of potential sources listed below.

The risk of *T. aggressivum* surviving the mushroom composting process

Background to composting

Production of mushroom compost. Agaricus bisporus mushrooms are grown in compost produced in a multi-stage microbial process. Mushroom compost is prepared commercially from grain straw (wheat), animal manure (from horses and poultry) and gypsum.

Phase 1. Phase 1 compost blending in large bunkers leads to high microbial activity and heating (Gerrits 1988). Temperatures may reach more than 70°C in the core of the bunker while being less than 50°C on the edges (Székely et al. 2009). Fresh air is blown in to ensure the process remains aerobic. Ammonia is produced in significant quantities. Phase 1 varies from 3 days to 3 weeks. The compost is periodically mixed to create a homogeneous blend.

Phase 2. Phase 2 compost is also the result of aerobic microbial activity under controlled temperature conditions (Straatsma et al. 1994; Siyoum et al. 2016). Phase 2 composting involves a controlled heat treatment. The typical thermal profile in phase 2 is a gradual rise in temperature driven by microbial activity, manual temperature maintenance at 58°C for 8 hours, 43-48°C for approximately three days, then cooling to 25°C. The composting process occurs in enclosed tunnels and air is circulated.

Phase 3. Phase 2 compost is inoculated in a tunnel with sterilised grain colonised with mushroom mycelium. For mycelial growth, the temperature of the compost is maintained for around 15 days at 25-26°C. At this point the colonised compost may be compressed, wrapped in plastic and chilled.

General microbiology of mushroom compost

Mushroom composting is fundamentally similar to other composting, although most research has focused on composting for waste management or soil amendment (Gerrits 1988; Székely et al. 2009), processes which are generally slower and less regulated than mushroom composting. The microbial communities of mushroom compost have most recently been examined by culture and culture-independent techniques (Székely et al. 2009; Siyoum et al. 2016). Mesophilic decomposing organisms dominate at the start of the composting process. As the compost heats, a suite of thermophilic organisms takes over. These micro-organisms are important for degrading complex organic substrates. At the end of this phase, when the compost is rested, a new collection of mesophilic organisms form the dominant community.

Effects of phase 1 and 2 temperature profiles on *T. aggressivum*

The heat profiles and ammonia in bulk composting shape the microbial community for mushroom growth and pasteurise the compost selectively. The temperature is reported to be sufficient to kill some pathogenic micro-organisms of concern from manure, such as *Listeria monocytogenes*, *Escherichia coli* O157:H7, and *Salmonella* (Weil et al. 2013), although these authors recommended regular monitoring of compost for contamination by such organisms. The heat and ammonia of composting do not sterilise the medium; bulk mushroom composting is a dynamic process, producing a living ecosystem of micro-organisms. Some micro-organisms remain static during phase 2 of composting and become active later when the temperature is lowered (Siyoum et al. 2016). The final microbial community is crucial; for example, the fungus *Scytalidium thermophilum* is important for growth promotion of *A. bisporus* (Straatsma et al.

1994). *Good quality* compost has a conserved structure to the final microbiota, with a lesser role for the input material in structuring the community (Székely et al. 2009).

While mushroom composting involves a series of regulated steps, the bulk nature of this farming operation means that it is impossible to apply exact conditions to every fraction of the final compost. Temperatures in the compost heaps fluctuate from the centre of the piles to the outside and the cooled compost is always colonised by microorganisms from the surrounding environment. A range of fungal moulds such as *Penicillium*, *Aspergillus* and *Trichoderma* are regularly observed on phase 3 compost, and need management (Fleming-Archibald et al. 2016).

Trichoderma aggressivum has not been detected in the wild, but one potential source is from compost components (Baars et al. 2011), followed by survival through the composting procedure. *Trichoderma aggressivum* is known to have a considerable tolerance to compost time-temperature treatments. A temperature of 60°C for 12 hours was needed to reduce *T. aggressivum* spores and infected compost inocula to below detectable limits (Grogan et al. 2011), but a later study found that this treatment was insufficient to eradicate all *T. aggressivum* compost inoculum (Lane & Cole 2013). Deliberate elevation of compost ammonia by addition of urea did not affect *T. aggressivum* (Lane & Cole 2013).

The risk of *T. aggressivum* contaminating phase 3 compost

Hygiene is important at all composting stages to prevent pathogen contamination from one phase to another. In particular, it is important to prevent contamination of phase 2 material with spawned phase 3 compost. It is recommended that phase 3 tunnels should be filled and emptied at different ends, with distinct equipment and that steam cookout or pasteurisation of tunnels is critical between batches (Kilpatrick et al. 2015)*. Because *Trichoderma* spores are sticky, airborne dispersal of individual spores does not appear to be a major feature of *Trichoderma* spread. However, *Trichoderma* is carried on dust particles and compost fragments, and windy sites were associated with increased disease (Seaby 1996). *Trichoderma* spores adhere widely upon site contaminations, and studies of *T. aggressivum* distribution on farms suggested that the main vectors were people, machinery and equipment (Seaby 1996; Rinker et al. 1997; Royse et al. 1999). Handling of infected phase 3 compost has been shown to disperse *T. aggressivum* spores and infected compost fragments throughout the production facility (Kilpatrick et al. 2015). To control *T. aggressivum*, all machinery and equipment must be thoroughly cleaned to eliminate remnants of compost on equipment that might harbour inoculum. A potential vector of *T. aggressivum* into composting facilities is haulage machinery returning from growing sites (Kredics et al. 2010; Kilpatrick et al. 2015).

The withdrawal of formaldehyde as a gaseous disinfectant and fungicide tray dips has been a particular problem for farms. There are several other disinfectants that are marketed in the mushroom industry for use as liquids and/or fogs but their effects at different concentrations on *T. aggressivum* are not established.

Other vector risks for *T. aggressivum* contamination of compost

Sciarid (*Lycoriella ingenua*) and phorid (*Megaselia halterata*) flies are common associates of mushroom compost. Sciarids and pepper mites (*Pygmephorus* spp.) have been indicated as vectors for *T. aggressivum* (Seaby 1996). Experiments with *L. ingenua* fungus gnats showed that they preferred mushroom compost containing *T. aggressivum* over compost lacking *T. aggressivum* (Cloonan et al. 2016). Insects are not regarded as important vectors of *T. aggressivum* in compost yards (Helen Grogan, pers. comm.), but they are persistent compost pests that are very difficult to eliminate from a farm environment. They are found in The Netherlands (e.g. Scheepmaker et al. 1997).

The risk of not detecting *T. aggressivum* in bulk compost

A selective medium favouring the growth of *Trichoderma* species over background moulds can be used for dilution plating of compost suspension. This method was capable of detecting about 10 propagules of *T. aggressivum* per gram of compost (Grogan et al. 2011). Air fall-out plates positioned near tunnel doors during emptying provide one method for monitoring for *T. aggressivum* (Kilpatrick et al. 2015). The relative lack of airborne *Trichoderma* dispersal means that fall-out plates detect spores on dust or small particles of compost, presumably limiting the sensitivity of detection for low rates of infestation (Rinker et al. 1997).

Polymerase chain reaction (PCR) diagnostic tests have been designed for *T. aggressivum* (Chen et al. 1999). These techniques appear best for accelerating identification of visible *Trichoderma* colonies. A method for qPCR detection of *T. aggressivum* has been developed and applied to compost samples (Lane 2010). This method was found to be capable of detecting *Trichoderma* propagules in phase 3 compost containing 0.01% infected compost inoculum. The sensitivity of the PCR method was said to be in general agreement with those of dilution plating and compost on agar, but no specific figures were described (Lane & Cole 2013).

Detection of *T. aggressivum* in phase 3 compost is difficult. During spawn run, the compost is largely inaccessible (Baars et al. 2011). Small volumes of material (e.g. 100-g samples) for qPCR may not be representative of the larger compost supply. They are also not suitable for detecting small isolated infestations that would nevertheless be crucial in a biosecurity context. For these reasons, work has been ongoing to develop a detection test for *T. aggressivum* in compost based on released volatiles (Baars et al. 2011). This test has not yet reached in-field application.

The risk of compost contamination by Mushroom Virus X

A viral disease of *A. bisporus* was first observed in the 1990s when it caused significant damage to the European mushroom industry (Eastwood et al. 2015). This disease complex is associated with double-stranded RNAs particles in the mushroom mycelia; collectively this disease has been given the name mushroom virus X (MVX). The browning disease symptomology associated with MVX has especially been noted in Ireland, The Netherlands and Belgium. MVX has not been observed in New Zealand. MVX appears to be associated with a complex of viruses (Kilpatrick et al. 2015), with recent sequencing suggesting one virus, AbV16 (Agaricus bisporus Virus 16) or 'Brown Cap Mushroom Virus' (BCMV), being especially involved in cap browning (Eastwood et al. 2015).

Phase 3 compost can become infected at compost yards. A large number of Phase 3 European compost samples (2013/2014) screened by RT-qPCR showed the presence of MVX viruses in 2.4-3.2% of samples (Fleming-Archibald et al. 2015). These authors recommended that compost producers should routinely test for the presence of viruses. However, testing compost for MVX is far from routine, RT-PCR is expensive, and these tests suffer from the same limitations of access and sample coverage as described for *T. aggressivum* testing in phase 3 compost.

Compost samples positive for MVX viruses were found to transmit viruses into healthy compost and resulting mushrooms. Healthy *Agaricus bisporus* mycelium is infected by anastomoses with fragments of infected mycelium or by dissemination of mushroom spores (Helen Grogan, pers. comm.). As with *T. aggressivum*, compost yard hygiene is critical to reducing the occurrence and transmission of MVX.

Acknowledgements

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References

Baars J, Rutjens J and Mumm R. 2011. Can volatiles emitted by compost during spawn run be used to detect green mould infection early? International Conference on Mushroom Biology and Mushroom Products (ICMBMP7).

Chen X, Romaine CP, Ospina-Giraldo MD and Royse DJ. 1999. "A polymerase chain reaction-based test for the identification of Trichoderma harzianum biotypes 2 and 4, responsible for the worldwide green mold epidemic in cultivated Agaricus bisporus." Applied Microbiology and Biotechnology 52(2): 246-250.

Cloonan KR, Andreadis SS and Baker TC. 2016. "Attraction of female fungus gnats, Lycoriella ingenua, to mushroom-growing substrates and the green mold Trichoderma aggressivum." Entomologia Experimentalis Et Applicata 159(3): 298-304.

Eastwood D, Green J, Grogan H and Burton K. 2015. "Viral Agents Causing Brown Cap Mushroom Disease of Agaricus bisporus." Applied and Environmental Microbiology 81(20): 7125-7134.

Fleming-Archibald C, Kilpatrick M, Ruggiero A and Grogan HM. 2016. Identifying Trichoderma aggressivum within the European mushroom industry. International Society for Mushroom Science (ISMS).

Fleming-Archibald C, Ruggiero A, Deakin G, Dobbs E, Burton J and Grogan H. Characterisation of the viruses associated with Mushroom Virus X (MVX) and detecting MVX-associated viruses within the European mushroom industry. International Society for Mushroom Science (ISMS). Amsterdam.

Fleming-Archibald C, Ruggiero A and M. Grogan HA. 2015. "Brown mushroom symptom expression following infection of an Agaricus bisporus crop with MVX associated dsRNAs." Fungal Biology 119(12): 1237-1245.

Gerrits J. 1988. Nutritional and compost. The cultivation of mushrooms. L. vanGriensven. Rustington, Darlington Mushroom Laboratories Ltd: 29-38.

Grogan H, Noble R and Lane C. 2011. Trichoderma aggressivum f. europaeum (Th2): Epidemiology in bulk Phase 3 systems. HDC Project M 50 Final Report.

Kilpatrick M, Fleming-Archibald C and Grogan H. 2015 "Understanding *Trichoderma aggressivum* in bulk phase 3 compost " MushTV factsheet 03/15, 8.

Kredics L, Garcia Jimenez L, Naeimi S, Czifra D, Urbán P, Manczinger L, Vágvölgyi C and Hatvani L. 2010. A challenge to mushroom growers: the green mould disease of cultivated champignons. Current Research, Technology and Education Topics in Applied Microbiology and Microbial Biotechnology. A. Mendez-Vilas. Extremadura, Spain, Formatex Research Centre. 2: 295-305.

Lane C. 2010. Trichoderma green mould - diagnostic assays for improved disease control. HDC Final Report for project M 48.

Lane C and Cole J. 2013. Project number: M 57 Mushrooms: Influence of ammonia during compost pasteurisation and disinfectants on eradication of Trichoderma aggressivum (Th2) Project leader: Dr Ralph Noble.

Lemmers G. 2010. Trichoderma in Bulk Phase 3 (Part 1). Mushroom Business. 40: 10-13.

Mamoun ML, Iapicco R, Savoie JM and Olivier JM. 2000. Green mould disease in France: Trichoderma harzianum Th2 and other species causing damages on mushroom farms.

O'Brien M, Kavanagh K and Grogan H. 2016. "Detection of Trichoderma aggressivum in bulk phase III substrate and the effect of T. aggressivum inoculum, supplementation and substrate-mixing on Agaricus bisporus yields." European Journal of Plant Pathology: 1-11.

Rinker DL, Alm G, Castle AJ and Rghei N. 1997. "Distribution of green mould on infected mushroom farms." Mushroom World 8(2): 71-75.

Royse DJ, Boomer K, Du Y, Handcock M, Coles PS and Romaine CP. 1999. "Spatal Distribution of Green Mold Foci in 30 Commercial Mushroom Crops." Plant Disease 83(1): 71-76.

Samuels G, Dodd SL, Gams W, Castlebury LA and Petrini O. 2002. "Trichoderma species associated with the green mold epidemic of commercially grown Agaricus bisporus." Mycologia 94(1): 146-170.

Scheepmaker JWA, Geels FP, Smits PH and Griensven LJLDV. 1997. "Control of the mushroom pests Lycoriella auripila (Diptera: Sciaridae) and Megaselia halterata (Diptera: Phoridae) by Steinernema feltiae (Nematoda: Steinernematidae) in field experiments." Annals of Applied Biology 131(3): 359-368.

Seaby D. 1987. "Infection of mushroom compost by Trichoderma species." Mushroom Journal (179): 355-361.

Seaby DA. 1996. "Investigation of the epidemiology of green mould of mushroom (Agaricus bisporus) compost caused by Trichoderma harzianum." Plant Pathology 45(5): 913-923.

Siyoum NA, Surridge K, van der Linde EJ and Korsten L. 2016. "Microbial succession in white button mushroom production systems from compost and casing to a marketable packed product." Annals of Microbiology 66(1): 151-164.

Straatsma G, Olijnsma TW, Gerrits JPG, Amsing JGM, Dencamp H and Vangriensven L. 1994. "Inoculation of scytalidium-thermophilum in button mushroom compost and its effect on yield." Applied and Environmental Microbiology 60(9): 3049-3054.

Straatsma G, Samson RA, Olijnsma TW, Dencamp H, Gerrits JPG and Vangriensven L. 1994. "Ecology of thermophilic fungi in mushroom compost, with emphasis on scytalidium-thermophilum and growth-stimulation of agaricus-bisporus mycelium." Applied and Environmental Microbiology 60(2): 454-458.

Székely AJ, Sipos R, Berta B, Vajna B, Hajdú C and Márialigeti K. 2009. "DGGE and T-RFLP Analysis of Bacterial Succession during Mushroom Compost Production and Sequence-aided T-RFLP Profile of Mature Compost." Microbial Ecology 57(3): 522-533.

Weil JD, Cutter CN, Beelman RB and LaBorde LF. 2013. "Inactivation of Human Pathogens during Phase II Composting of Manure-Based Mushroom Growth Substrate." Journal of Food Protection 76(8): 1393-1400.

Confidential report for:
Meadow Mushrooms

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August 2016

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DISCOVER. INNOVATE. GROW.

Niki Wright

Out of Scope

From: Dave Hyland
Sent: 16/02/2017 5:24 p.m.
To: Shane Olsen
Cc: Richard Lardner
Subject: Imported Substrate Support

Good afternoon Shane,

We would be most appreciative if you could please consider the attached as support towards the importation of Phase 3 Substrate. Feel free to share with colleagues in particular Stephen Butcher (the 2 letters have been addressed to him) and other key decision makers within MPI or wherever this may assist. The attached documents consist of:

- Draft Veterinary Certificate which the NVWA drafted for NZ and can be adapted further with MPI direction. Walkro produces the substrate and handles raw animal materials in accordance to the EU1069/2009 and EU142/2011 regulations.
- The summarised production protocol and flow chart
- Walkro supply chain and photos highlighting the technical, professional and hygienic facility and process the substrate progresses through. Verification of our submission describing the facility and resources where the substrate is produced.
- Letter of support from Foodstuffs
- Letter of support from Progressive where both letters validate our submission that the quality of the mushroom using imported substrate is vastly superior than anything else produced in New Zealand and the significant demand for our product to re-enter the market. Further to this, as of mid-February 2017 none of the supermarkets have near enough quality mushrooms in the market place to honour promotional programs. In particular the North Island stores cannot use product from Meadow Mushrooms (South Island) due to its high rejection rate based on poor shelf life. In some cases they have to use it but because they have no other alternative. Mushroom suppliers are reportedly working with a poorer straw quality at present and yields are around 30-40% where they should be 50-65%. Again our yields utilising imported substrate was approximately 78-91%.

I sincerely hope what we have shown from the one supplier (Walkro/DTO) details how superior and state of the art their operation is compared to anything we have here in NZ. Furthermore we will have our own world class facility here in Mercer which will more than adequately comply with the new proposed standards and ensure Bio-security is paramount.

I look forward to liaising further

Kind Regards

Dave Hyland
Chief Executive

s 9(2)(a)
Tel: s 9(2)(a)
Mob: s 9(2)(a)
55 Morrison Rd, Pukekawa, RD1, Tuakau 2696.

mercer MUSHROOMS

Pride of the Bombay Hills

03/02/17

Steven Butcher
Ministry for Primary Industries
Pastoral House, 25 The Terrace
PO Box 2526
Wellington 6140

Re: Support to Mercer Mushrooms and the Importation of Phase 3 Substrate

Dear Steven,

We would like to take this opportunity to offer our support to Mercer Mushrooms efforts to import Phase 3 Substrate into New Zealand.

Mercer Mushrooms has been a reputable supplier of mushrooms to Progressive Enterprises for a number of years.

When Mercer Mushrooms changed to growing mushrooms using the imported substrate instead of compost made in New Zealand the result was a higher quality product: Our stores were reporting an extended shelf life which lowered food waste within our stores and no doubt within consumers home also.

Unfortunately, mushrooms are one of the highest food waste products within our Produce department and we have been working hard to lower the level of food waste associated with mushrooms. However, this remains a real challenge for our business.

With Mercer Mushrooms now unable to produce product for us there has been a gap left in the market place which has been difficult to fill. Our only option has been to ship more product up from the South Island. This results in unnecessary freight movement, which has negative environmental impacts. Mushrooms are delicate, so the transport over such a distance also negatively impacts quality and increases food waste.

We feel the appearance, shelf life and consistency of supply from a North Island base Mushroom producer using imported substrate offers our North Island consumers an experience they don't receive currently.

We are excited about the new purpose built facility that is nearing completion at Mercer, and the efforts implemented to guarantee even higher levels of hygiene compliance, quality and overall operational standards.

We see the benefits of utilising the imported substrate for NZ mushroom growers being both economically and environmentally valuable. Mercer Mushrooms will offer employment opportunities to the Pukekohe, Tuakau and Pukekawa regions and through delivering a high quality product export opportunities could also present themselves.

Countdown Supermarkets looks forward to the successful implementation of the New Import Health Standard and for all Mushroom producers to be unimpeded and allowed to operate in an open market through importation of Phase 3 Substrate.

s 9(2)(a) [redacted]

Sincerely

s 9(2)(a) [redacted]

Merchandise Manager Produce
Countdown Supermarkets

FOODSTUFFS
NORTH ISLAND

Date 9/02/2017

Steven Butcher
Ministry for Primary Industries
Pastoral House, 25 The Terrace
PO Box 2526
Wellington 6140

Re: The Importation of Phase 3 Substrate from Mercer Mushrooms

Dear Steven,

We are writing this letter to offer our support towards Mercer Mushrooms.

Mercer Mushrooms (formerly Cresta Mushrooms) have been a key category supplier for many years to Foodstuffs. We have been fortunate to receive a high quality mushroom product from them. This is particularly since they've been procuring imported substrate as part of their supply chain.

Foodstuffs prides its self on offering our customers consistent top quality locally grown produce. We support Mercer producing a superior quality product.

In terms of protecting NZ's biosecurity we know Mercer are undertaking a significant upgrade and expansion to their facility to international standards.
This commitment and investment by a local Supplier is supported by us and will bring some competition to the market which will greatly enhance the offer to our customers.

Thank you for considering our letter. Yours sincerely

s 9(2)(a)
[redacted]

Business Manager Fresh Produce

Foodstuffs North Island

s 9(2)(a)
[redacted]

Koninkrijk der Nederlanden

GEZONDHEIDSCERTIFICAAT
(veterinair certificaat) certificaatnummer:

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Nederlandse Voedsel- en Warenautor teit	Netherlands Food and Consumer Product Safety Author ty	Niederländische Behörde für Lebensmittel- und Produkts cherhe t	Autor té néerlandaise de sécurité san taire de l'alimentation et des produits de consommat on	Autor dad holandesa de la seguridad Alimen aria y de los Productos de co sumo
Gezondheidscertificaat	Health Certificate	Gesundheitsbescheinigung	Certif cat Sanitaire	Certificado Sanitario

VETERINARY CERTIFICATE FOR THE EXPORT OF PROCESSED ANIMAL MANURE PRODUCTS CONTAINING HORSE AND/OR CHICKEN MANURE FROM THE NETHERLANDS TO NEW ZEALAND

I. IDENTIFICATION OF THE PRODUCTS

Product no.	Product	Species	Approval no.	Country of origin

Product no.	HS-heading	HS-description (HS-4)	Storage temperature	Type of packaging and number of packages	Nett weight

Batch or lot number :
Container number :
Seal number :

II. ORIGIN OF THE PRODUCTS

Product no.	Approval number of manufacturing plant	Name and address

Name and address of exporter
Date of export :
Place of loading :

III. DESTINATION OF THE PRODUCTS

Means of conveyance :
Identification of the means of conveyance :
Name and address consignee :
Place of destination :

IV. HEALTH ATTESTATION

The undersigned O ficial Veterinarian certifies that the following processed animal manure product satisfies the requirements of New Zealand's Import Health Standard: Processed Animal Manure Products:

Eligibility:

1. The animal manure in this product is sourced only from horse and/or chicken;
2. The horse manure in this product is not sourced from a holding subject to animal health restrictions pertaining to glanders, vesicular stomatitis, anthrax or rabies in accordance with national and EC legislation;
3. The first phase of composting of the product was completed at a production plant registered by the authority of New Zealand;

Production plant requirements:

4. The production plant is approved by the Competent Authority as a composting plant as defined in European Union Regulation (EC) No 1069/2009;
5. The production plant manufactured the product in accordance with the requirements in Annex V of the European Union, Commission Regulation (EU) No 142/2011;
6. The production plant was audited by the Competent Authority during the last year, and there are no outstanding non-compliances at the time of manufacture of the product for export to New Zealand;

Processing requirements:

7. During the first phase of production, the animal manure in this product was composted in enclosed concrete compartments for a period of no less than five days. During this phase of production the

animal manure in the product was composted at a temperature of 80°C, as measured by a sensor placed within the compost near the top of the pile, for no less than 72 hours;

8. Precautions have been taken in order to prevent contamination with other animal ingredients after the first phase of composting;

Packaging requirements:

9. The packaging in the consignment is strong enough to securely contain the product within it, and its exterior is clean and free from organic matter and other contaminants at the time of its export.

NVWA Waarmerk

Gedaan te / Done at / Ausgefertigt in / Fait à / Hecho en
Op / On / Am / Le / El

Handtekening officiële dierenarts / Signature of the official veterinarian / Unterschrift des amtlichen Tierarztes / Signature du vétérinaire officiel / Firma veterinario oficial

Naam in hoofdletters / Name in capital letters / Name in Grossbuchstaben / Nom en lettres capitales / Nombre en letras capitales

Walkro België BVBA

1. Introduction.

Untreated organic fertilizers or incomplete treated mushroom substrate can carry organisms that may transfer dissease onto other growths, vegetation or individuals. New Zealand authorities wants to exclude the risk to bring undesirabled organisms to New Zealand territory by mushroom substrate. This protocol indicates how this risk is controlled and minimized.

2. Product description.

Used raw materials are: horse manure, poultry manure, straw, gypsum and proces water. In exceptional cases poultry manure can be replaced by an alternative nitrogen source. After being processed the product is specific suitable for the cultivation of mushrooms.

3. Proces description.

Proces	Days	Description
Phase 1a	1 – 3	The raw materials are being mixed together. This mix is being filled in a bunker to absorb the added proceswater and gets a first heat treatment (60 – 70°C)
Phase 1b	4 – 6	Temperature treatment (80°C) in order to fermentation of the product
Phase 2	4 – 6	Pasteurisation (8 hrs. > 56°C, reduces diseases) and conditioning (45 – 50°C, break down ammonia). Substrate gets selective for mushroom mycelium.
Phase 3	14 - 21	Incubation of substrate by mycelia that was added between phase 2 – 3. Temperature roughly 23 – 28°C.

All phases are completely indoor and aerated. All phases are computer controlled and process data are stored in the climate control computer database. Handling in between phases all are done indoor and mechanised.

4. Critical Check Point.

Temperature	Duration	Proces step	Documenting	Remark
80 °C in top layer	72 hrs	Phase 1	Database climate control computer	Allowable temperature deviation 2,5°C

5. Track & Trace.

Each container will be sealed after filling and has an unique ID. This ID is related to a unique batch of substrate. Data of this unique batch can be traced at the substrate manufacturer facilities ‘till the start of the production process.

6. Documents.

Phase 3 substrate loads	Container phase 3 substrate blocks
• Weigh voucher • Handelsdocument	• Invoice • Packing list • Manufacturer’s Certificate • New Zealand Sea Container Declaration • Phytosanitary Certificate • Bill of lading • Process Flow Chart (A7, Walkro)
Transport is announced to the Belgian authorities (VLM) through an online application.	Transport is announced to customs in the port of shipping. Documents will be sent to customer by expres to clear the container at it’s arrival.

7. Competent authorities.

The Netherlands	Belgium	New Zealand
nVWA	FAVV	MPI

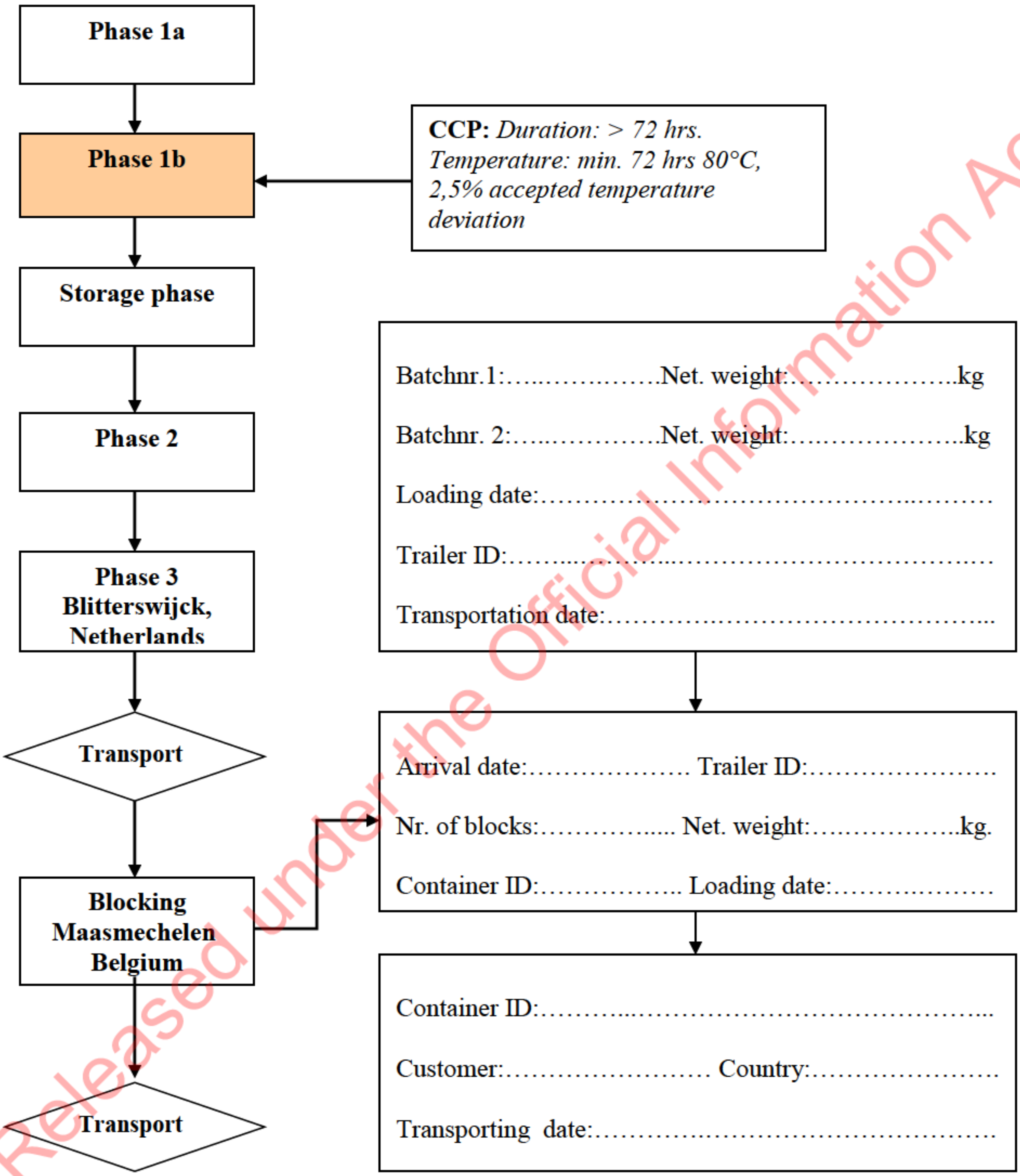
The competent authorities are operating under responsibility of the national ministry they are part of.

8. Responsibility.

On behalf of Walkro the department of Sales is responsible for this procedure.

Walkro België BVBA

Production Flow Chart



Place:………………………………………………….. Date:…………………………………………......

Name:……………………………………………….. Signature:……………………………………

Walkro - DTO BV Supply chain

CONFIDENTIAL

s 9(2)(b)(ii)

s 9(2)(b)(ii)

[redacted]

s 9(2)(b)(ii)

Mercer Mushrooms

Submission: New Import Health Standards for Mushroom Growing Medium & Processed Animal Manure Products

Mercer Mushroom Management
8-2-2017

55 Morrison Rd • Pukekawa • RD 1 • Tuakau 2696 • 09 233 4162

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8th February 2017

To: Plant Imports
Plants, Food & Environment
Ministry for Primary Industries
PO Box 2526
Wellington 6140

From: Mercer Mushrooms
RD1 Tuakau 2696
Dave Hyland, Chief Executive
s 9(2)(a)

By email: plantimports@mpi.govt.nz

SUBMISSION ON "Import Health Standard (IHS) for Phase 3 Mushroom Growing Medium" and "Processed Animal Manure Products".

Mercer Mushrooms Ltd is satisfied the new import risk analysis provides comprehensive controls in relation to the importation of Phase 3 Mushroom Growing Medium and Processed Animal Manure Products. We appreciate and acknowledge the substantial amount of work that MPI and other stakeholders have contributed, additionally to the work s 9(2)(a) (MPI Belgium) has invested whilst developing the new import health standards.

Acknowledgement that if a country of origin is not a country of freedom, or is not a pest free area, then a systems approach will be submitted for importation. A systems approach and an export plan provided by Walkro and their established export partner The Dutch Trading Office of the Netherlands (DTO) clearly details basic and targeted measures. These measures and processes are replicated throughout their 3 facilities in Blitterswijck (The Netherlands), Maasmechelen (Belgium), and Pilzhof (Germany). Documented risk management and hygiene procedures from Walkro/DTO underline the high-level professionalism and worldwide compliance standard credibility these companies have in the mushroom industry. In addition the heat treatment that is performed at Walkro/DTO has been proven to show no identification of any risk organism from horse and chicken manure. It's widely recognised the Dutch are leaders in worldwide mushroom production, and Walkro are themselves leading edge. Significant work has been undertaken by Walkro/DTO, the Dutch MPI equivalent (NVWA) and New Zealand's MPI.

It's noted that appropriate documentation labelled as mushroom growing medium containing horse and chicken manure is required accompanying the goods and on official certificates.

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We note and agree that inspection on arrival may be required for MPI to verify compliance with the requirements of the IHS.

We also note the importance to manage any residual risk through effective post clearance conditions. In principle, we accept the post clearance requirements stated however make some suggestions to heighten hygiene and practicality processes through this submission.

The proposed phase 3 substrate from Walkro/DTO is produced in a large scale facility that is world leading not only in the mushroom industry but generally in industrial technology. The product produced is of the highest possible quality (our yield data in this submission will show our improvements) which will allow mushroom growers in New Zealand to produce world class mushrooms. This has a flow on effect not only for New Zealand growers and customers, but to the wider community via economic, environmental and societal benefits. Our desire to import Phase 3 substrate from Walkro/DTO is simple. It's the best quality in the world, supplied to more than 30 countries including those with stringent biosecurity, and we cannot source anything from New Zealand. We have tried.

Our submission will support the above benefits, growth opportunities and biosecurity compliance of the new IHS.

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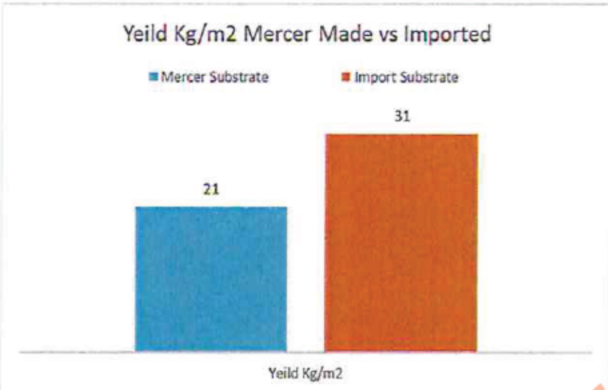
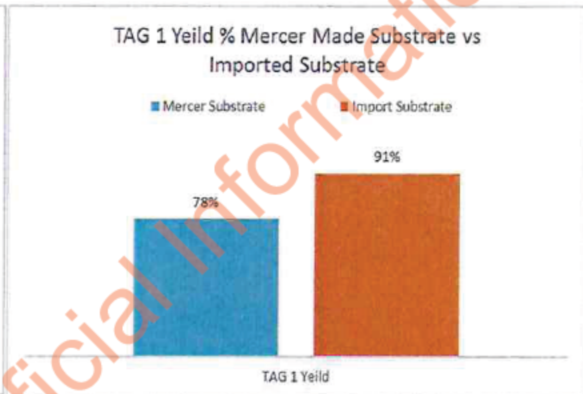
Benefits of Imported Phase 3 Mushroom Substrate

Mercer Mushrooms imported phase 3 mushroom substrate from Walkro/DTO for a period of 7 months in 2016 and had extremely successful results which are illustrated below.

On the commencement of utilising imported substrate from Walkro/DTO, both yield and quality increased exponentially from what was being achieved out of substrate made on our New Zealand site in the past. This was attributed to the heavier, firmer, whiter mushrooms that were being harvested from the growing beds. In addition to this our harvesting yields increased by a massive 47% which had a significant impact on the efficiencies of the business and productivity, in particular labour as the largest operating cost.





(*Please note in the 2nd diagram Tag 1 Yield refers to 1st Grade Quality*).

With these on site efficiencies, there was a significant market response to our higher quality product. This was reflected by the increased first grade quality product which dramatically increased from 78%-91%. Improved sales throughput occurred as well as demand for mushrooms from customers. Customer preference for a 1st grade quality white button mushroom is for a closed, firm, white, mushroom.

Like any primary industry business, we at Mercer Mushrooms are always striving to improve productivity out of our crop. We experienced a yield increase of 47% on average from the Walkro/DTO imported substrate. In addition to this our crop production variations smoothed due to the high quality substrate consistency. We expect to be able to further improve the efficiencies of our business with imported substrate in a newly built s 9(2)(b)(ii) world class facility, currently under construction due for completion April 2017. This way we will be able to market a high value, high quality product to both domestic and export markets. This is in line with our own and MPI's export goal wanting to capture Asia's growing economies with high value consumer products through improvements in productivity and sustainability.

The improvements in productivity, efficiencies and sustainability resultant from imported phase 3 substrate have flow on economic, environmental, and societal benefits which are described below.

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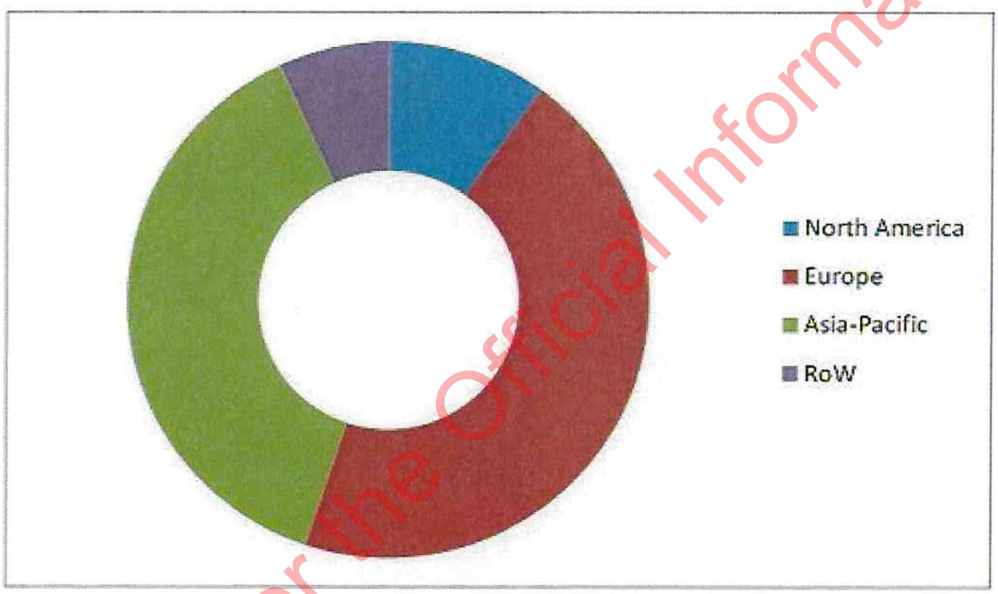
Economic Impact

The consumption of mushrooms throughout the world is expected to increase to over $50b by 2019, at a rate of 9.6% CAGR from 2014. This can be attributed towards the increasing demand for non-processed fresh produce, the growing awareness about health & wellbeing, and Mushrooms recent status as a super food (Market and Markets, 2015). By importing Phase 3 mushroom substrate Mercer Mushrooms will be able to produce a product that can be marketed for export. This will contribute towards the government's business growth agenda and MPI's primary industry export goal of reaching $64b by 2025. Without the imported substrate Mercer Mushrooms will not have the opportunity to produce consistent quality to export standard.

Mushroom Market Share (Value), by Region, 2013



(Market and Markets, 2015)

Employment
Through the use of imported phase 3 mushroom substrate Mercer Mushrooms will be able to re-employ many of the 85% of staff that were laid off when substrate permits were ceased, many of whom are still looking for full time work. In addition to this many more jobs are going to be created to take Mercer's work force up to 150 permanent employees from the local communities including Huntly, Meremere, Tuakau, Pukekawa and surrounding areas where some unemployment levels are over 20% (Statistics New Zealand, 2013).

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Market Growth and Trade

The phase 3 mushroom substrate that is produced by Walkro/DTO in Europe is of a much higher standard than what could ever be produced in New Zealand. Progressive Enterprises Ltd. and Foodstuffs NZ Ltd. have both categorically stated that mushrooms produced between January and July of 2016 from Mercer Mushrooms have been some of the highest quality they have sold through their retail outlets ever, of which were yielded from Walkro/DTO Phase 3 imported Substrate.

Healthy fresh produce consumption increased by improving quality, availability and affordability (Centres for Disease Control and Prevention, 2011). Imported phase 3 substrate will continue this trend by significantly improving the quality of the New Zealand mushroom industry therefore adding to growing consumer demand.

White button mushroom quality is defined by the whiteness of the cap, the firmness, the weight, the size, and shelf life. All of these aspects improved through the use of imported phase 3 mushroom substrate, the extended shelf life allows greater access to high end produce markets throughout Asia and the Pacific where firm bright white mushrooms are the minimum standard.

In addition to the export potential, importing mushroom substrate will allow Mercer Mushrooms to increase European trade by up to s 9(2)(b)(ii) per annum. For sake of utilisation, thousands of empty refrigerated containers bound for New Zealand to cater to various primary exports can be utilised for imported substrate. This scenario encourages global trade, provides freight efficiencies, lowers and negates carbon footprint and food miles.

Capital Investment

It is important to note that importing substrate is not importing mushrooms, a high-tech world class multi-million dollar facility is being built at Mercer Mushrooms to allow us to mitigate any potential residual bio-security risk for the New Zealand Mushroom Industry. It is in our best interest to protect our own industry from any risk that this product may pose.

The few mushroom facilities remaining in New Zealand have invested many millions of dollars to produce for the New Zealand mushroom market. However, with monopolistic behaviour occurring in the absence of Mercer Mushrooms in the market, potential for high quality imported mushrooms has become a market risk. This is due to the high sustained retail prices consumers have had to pay for average-low quality product.

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Environmental Impact

Higher Quality Product

Raw materials from Europe are more suitable for making top quality mushroom substrate. There is more quality horse manure and bedding easily accessible and a better straw quality than what is available in New Zealand. Also the heat treatment conducted at Walkro/DTO has proved no hazard identified in mushroom substrate containing horse and poultry manure. Walkro/DTO's facilities are among the most modern in the world. Costing tens of millions of Euro, this gravity of outlay would be extremely difficult to replicate. They have their own modern laboratory and high-quality processes which without significant scale would be unaffordable. In terms of scale, Mercer Mushrooms demand on a weekly basis from Walkro/DTO would be approximately s 9(2)(b)(ii) tonnes/week, where they produce s 9(2)(b)(ii) tonnes per week of Phase 3 substrate for their own and export markets. Testing and analysis are absolutely necessary to make high quality substrate of a consistent grade. Substrate plant managers have a unique set of skills and knowledge which leads towards vast experience with mushroom substrate; these skills are rare throughout the world. As a result, there is no doubt that the European substrate is a superior product to anything achievable in New Zealand.

Reduced disease risk

The high level of technology utilised in Europe allows the product to be consistent which is critical to minimising disease risk. In the past at Mercer, we have experienced issues with *Trichoderma Harzianum* and other unwanted fungus while producing small scale low quality substrate due to poor raw materials, breakdowns and human error. This happened at Mercer on multiple occasions every year, it also occurs in every substrate facility that does not have the systems and technology which are present at Walkro's three European plants. In our experience we had no diseases associated with Walkro/DTO substrate during the 7 months we produced with it (35 containers used from January to July 2016). They've been exporting for many years to 30 countries including Japan which has one of the most stringent biosecurity protocols in the world, without any issues. New Zealand is the only country to date they have had an issue with the NPPO (MPI). DTO is committed to supplying a world class high-quality product together with Walkro.

Council consent

Council consents to build a substrate plant are extremely hard to obtain. It would be difficult to construct a facility near our existing mushroom growing plant, this is because the Waikato Regional Council would be very reluctant to grant resource consents to allow composting in order to produce mushroom substrate. The initial stages of producing substrate releases high levels of odorous ammonia to the surrounding environment, this has impact on neighbouring residential properties. The level of negativity is well published in the media surrounding the production of mushroom substrate. Mercer Mushrooms has had challenging experiences with odour and the shifting urban communities which have also closed a plant in Morrinsville.

Reduced pollution

The production of Mushroom substrate has significant environmental impacts if expensive modern technology is not used. High levels of nitrates are used during the breakdown and

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composting process, in addition the release of ammonia during the first phase can be released to the atmosphere if air is not vented through sophisticated sulphuric acid scrubbers. By importing substrate Mercer Mushrooms avoids the risk of polluting New Zealand's environment. In addition, businesses now hold a social responsibility not to impact on its neighbours and disrupt communities which composting facilities often do.

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Social Impact

Health Benefits

"Often grouped with vegetables, mushrooms provide many of the nutritional attributes of produce, as well as attributes more commonly found in meat, beans or grains. Mushrooms are low in calories, fat-free, cholesterol-free, gluten-free, and very low in sodium, yet they provide important nutrients, including selenium, potassium (8%), riboflavin, niacin, vitamin C, vitamin D and more." (Mushroom Benefits, 2017)

With the ever-increasing obesity rates throughout New Zealand, the Pacific Islands and many other countries around the world, Mercer Mushrooms strives to increase the consumption of mushrooms via imported phase 3 substrate. This is due to the quality of mushroom produced which improves the shelf life, eating quality and appearance for the consumer. Researchers estimate that if mushrooms are substituted for red meat in one meal every week, this will contribute towards weight loss on its own. (Kavita H. Poddar, 2013).

Quality Assurance

Walkro/DTO will provide assurance and all certification requested by MPI of its processes and procedures. Their SOP's and management systems are internationally accredited. Mercer Mushroom's comply with different quality assurance programs, this gives customers confidence in our product that it is safe and sustainable. We hold Woolworths Quality Assurance (WQA), NZ GAP, and GS1 accreditation. These assurance programs are maintained through extensive regular auditing; maintaining these certifications allows a constant supply of product to many customers including Progressive Enterprises, Foodstuffs, Turners and Growers, Mg Marketing, wholesalers and many local customers. In addition to the product accreditation, staff are trained in food safety to ensure correct product handling and safety.

Request for Standard Changes:
It is in our best interest to ensure that we treat imported phase 3 substrate with care and in the most hygienic manner. For this reason, we would like to request some changes to the post clearance conditions to further protect our business and industry by heightening hygiene standards.

1. In regards to clause (2) a) of the Post Clearance Conditions for Phase 3 Growing Medium, we propose that all waste packaging material associated with imported growing medium be sterilised by subjecting it to a steam out process in line with that of the growing medium at the termination of a crop. On completion of sterilisation, for operational hygiene standards it is proposed that this material is then removed off site.
2. In Regards to Clause (2) b) of the Post Clearance Conditions for Phase 3 Growing Medium, we propose that any of the waste product that is removed during the cleaning process be sterilised by subjecting it to a steam out process in line with that of the growing medium at the termination of a crop. On completion of sterilisation, for operational hygiene standards it is proposed that this material is then removed off site with spent substrate.
3. In Regards to Clause (2) c), d), and e) of the Post Clearance Conditions for Phase 3 Growing Medium, we propose that a demarcation zone be setup for staff and personnel entering and exiting the facility. This is to ensure clean clothing and footwear is worn on entry, these items can then be removed and discarded in a sterile way or washed and cleaned on exit.
    a. Operational logistics occur frequently between growing rooms throughout the day, current proposed growing room conditions are unlikely to be effective control points; whereas with a dedicated demarcation zone to screen and change, diseases will be much more effectively controlled and contained within the facility.
    b. Dedicated sterilising facilities for harvesting equipment and machinery are setup at intervals in common hallway areas directly adjacent to growing rooms, which are within the confined facility to assist with disease control and containment

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Summary

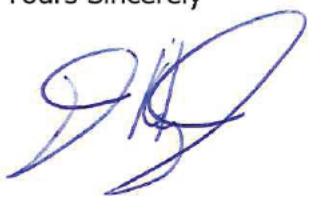
Mercer Mushrooms is a New Zealand family owned business with close interests in other related industries including agriculture, aquaculture, and horticulture. We understand the importance of bio security and believe European phase 3 mushroom medium is of unmatched quality and sanitary levels.

The work conducted by MPI to analyse the risks involved with importing phase 3 growing medium is thorough and extensive. It has shown that under strict hygiene measures and procedures the product is safe for importation.

Including the s 9(2)(b)(ii) injected in the new facility, the total value of the facility represents in excess of s 9(2)(b)(ii) of private kiwi investment. This monetary sum validates the belief Mercer Mushrooms have towards the importation of Phase 3 substrate. This will allow us to achieve our major goal of becoming a 1st Class Grower utilising the highest quality resources to produce the highest quality mushroom. The benefits are to the NZ consumer, our economy via exports & employment, and our industry as we embrace leading edge technology whilst attracting a new consumer demographic. The environment is also a beneficiary as New Zealand will be less one compost producing facility.

European phase 3 growing medium will satisfy the goals that MPI and the government business agenda have set forth for the primary industries and trade to add value to the New Zealand economy and GDP.

Yours Sincerely



Dave Hyland
Chief Executive

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References

Centres for Disease Control and Prevention. (2011). *Strategies to Prevent Obesity and Other Chronic Diseases: The CDC Guide to Strategies to Increase the Consumption of Fruits and Vegetables.* Atlanta: Department of Health and Human Services. Retrieved from Centre for Disease Control.

Kavita H. Poddar, M. A.-J. (2013). Positive effect of mushrooms substituted for meat on body weight, body composition, and health parameters. A 1-year randomized clinical trial. *Appetite*, 379-387.

Market and Markets. (2015, Jan). *Mushroom Market by Type (Button, Shiitake, and Oyster), by Application (Fresh Mushrooms and Processed Mushrooms (Dried, Frozen, and Canned)), & by Region - Global Trends & Forecast to 2019*. Retrieved Feb 2, 2016, from Markets and Markets: http://www.marketsandmarkets.com/Market-Reports/mushroom-market-733.html

Mushroom Benefits. (n.d.). Retrieved Jan 27, 2017, from Fresh Mushrooms Natures Hidden Treasure: http://m.mushroominfo.com/benefits/

Statistics New Zealand. (2013). *2013 Census.* Retrieved January 2, 2017, from Statistics New Zealand: http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-a-place.aspx?request_value=13680&parent_id=13654&tabname=&sc_device=pdf

NZEHA

8 February 2017

Ministry for Primary Industries
PO Box 2526
Wellington 6140

Dear Sir/Madam

Submission re: Draft Import Health Standard Processed Animal Manure Products. ANMANURE.GEN, and related Risk Management Proposal for Processed Animal Manure Products: ANMANURE.GEN

The New Zealand Equine Health Association represents the New Zealand equine industry on maters relating to equine welfare and biosecurity and was recognised as having mandate from this industry by the Minister of Primary industries in 2014.

NZEHA's comments on the Rapid Risk Assessment: Mushroom substrate containng horse and poultry manure:

- This risk assessment is based on inferences made about the "processing" to which the horse manure is exposed. No detail of the actual process is described in the risk assessment. It concludes risks are on the basis that the process will heat all horse material to 80^{O}C for 1364 minutes then presence of the equine pathogens is assumed to be eliminated.
- It is NZEHA's view that the risk assessment should assess all the system risks which should include the risk of cross-contamination and the risk

that the process can not always achieve the stated time temperature parameters for all of the product.

- It is our view that this Rapid risk assessment is superficial and does not describe the process sufficiently to allow useful risk assessment.

Feedback on the Risk Management Proposal: Mushroom substrate containing horse and poultry manure.

- The Section 2 Background describes the situation leading up to the development of this risk analysis. We note that importations occurred that were in breach of an import health permit. Such illegal activities allow for substantial fines under the Biosecurity Act 1993 and we are concerned that MPI appears to have ignored this avenue of redress and expedited work to facilitate said imports, implicitly suggesting that such behaviour is to be rewarded.
- It is in this document that more detail on the process used is described in some detail. Table 1 is not especially clear but confirms that not all compost acheives 80-'C for 1364 minutes which is the premise that the rapid risk assessment is based upon. This information is more usefully included in the risk assessment document so that the assessor can assess the risk appropriately.
- The assumption that of the EU council Directive manages the risk of a range of equine hazards being present in the horse manure is inappropriate as manure management is not discussed in the directive at all. See feedback later in this document on this point.
- NZEHA is concerned that the existance of an EU Council Directive is viewed as a risk management measure sufficient to assess the likelihood of exposer as negligible with out some including supporting corroborating evidence as to the level of conpliance by EU countries with said directive.
- The risk assessment thus needs to be re assessed on the assumption that all product will achieve 49^{o}C rather than that some product does achieve 80^{o}C.
- NZEHA notes that Part 6 (5) has a number of missing equine pathogens that may from time to time be present in horse manure in EU countries. These include equine parasite eggs and larvae, and while many of these species may be present in New Zealand there is a distrubing trend world wide towards the development of resistance to many anthelmintic groups and consideration of this risk appears absent in the risk analysis.

- NZEHA wonders why Equine corona virus and exotic ticks have not been included as hazards that would likely be present in horse manure.

Feedback on the Draft IHS is as follows:

- The name of the Import Health Standard is not consistant with its purpose and application. The purpose in the introduction section states the IHS is very specific to equine and chicken manure processed at one production plant in one country. The Part one requirements in the same IHS then broadens its use to include imports from all European Union countries and then the IHS title for "*Processed Animal Manure Products*" suggests a far wider range of manures and sources again. The name of this IHS should reflect the purpose and application which in this case seems to relate to production from a single plant.
- NZEHA was perturbed at the nonspecificity of the references included in the *Part 1 Requrement section 1.3*. The *incorporation by references* into this IHS total is in excess of 250 pages and it is NZEHA's contention that MPI should be more energetic and precise and assist the reader by annexing the pages within the references that apply to this IHS to the document as well as including the link to the whole directive.
- Part 1:Section 1.5 (1)a requ res that the manure processing plant be approved. Approved plants can produce non compying products. NZEHA seeks more robust verification that the risks associated with this product have been managed. The declarations in Part 2 are weak in this respect and need to include evidence that the product in the shipments complies with the EC manufacturing requirements and the paperwork should include copies of the most recent plant audit and validation results as described in the associated regulations. The word "outstanding" (as is included in the draft certificate in the guidance document) is superflous and could be misinterpreted.

- The use of the EU Council directive referenced in Part 1.5: (1) c) is inappropriate in terms of ensuring horse manure is not sourced from areas subject to animal health restrictions. The EU Council directive stated is silent on the treatment of horse manure during periods of horse movement restriction and it is entirely possible under this directive that horse manure collected from diseased equines under movement control could move for incorporation into animal manure products once the movement control restrictions are lifted.

- NZEHA seeks more detail as to the mechanism and time frames relating to the proposed approval described in Part 1.5 (1) d). Will this be undertaken annually by an MPI auditor and be in addition to the audits carried out by the Competent Authority as described in Part 1.5 (2)? Will the outcome of these audits be publicly available?

- Given the historical experience of an extremely long lag time between an index case occuring and disease notification, to enable traceability in a new/emerging or contagious disease scenario then the documentation accompanying the goods being imported should include countries of origin of the source manure as a minimum so that New Zealand can assess its own risk in the face of a new/emerging or exotic to NZ disease outbreak reported in Europe.

- Part 2: General processing requirements (2) As is discussed in the feedback on the Risk assessment and Risk management documents NZEHA has concerns that product that has not been verified as achieving adequate time and temperature parameters could be exported. It is unsatisfactory that the information from a single sensor be relied upon to verify that an indeterminable amount of product is compliant. Dated information logs from Multiple sensors placed at the coolest points in the compost pile must show that the animal manure product has been composted at a time and temperature of **not less than 80°C for no less than 72 consecutive hours. These logs must** be the minimum amount of information that is provided to the Official Veterinarian for them to sign an export certificate for this product to New Zealand.

The NZEHA feels that insufficient information has been provided to allow the assumption that the composting process is capable of processing all material to the 80°C and holding it there for 72 hours. Information from Cornell University Science and Engineering departments describe well designed indoor commercial compost systems as taking three to five days to heat up to 60-70°C and recommend compost management to keep the compost pile below 65°C. This is incongrous with the information presented in the consultation documents. The time temperature treatment is the key risk mitigation being used to certify this product for import into New Zealand.

In additon to concerns that the composting method can not reliably and consistently meet the required time temperature parameters in all seasons, NZEHA also has concerns that measures to ensure Cross contamination of processed material with unprocessed material are not subject to verification and inclusion in the certificate. For large volume product such as this housekeeping, fly and vermin control are an ongoing challenge and capable of high variability thus should receive ongoing verification to provides appropriate assurance that compost arriving in New Zealand has not in fact been contaminated with multiple horse pathogens.

The New Zealand Equine Health Association is a GIA partner with MPI and has expresssed a desire to consult on these standards that are so critically important to managing risks to the new Zealand equine industry. To that end are concerned that we were not specifically notified that these standards were out for consultation and the lack of notification has meant this submission has been rushed and subject to less research than the industry would have prefer ed.

The NZEHA welcomes the opportunity to consult and discuss any aspect of this submission.

Yours sincerely

Dr Patricia Pearce

Executive Advisor to New Zealand Equine Health Association

PIANZ

21 January 2017

Ministry for Primary Industries
PO Box 2526
Wellington 6140

Dear Sir/Madam

Submission re: Draft Import Health Standard Processed Animal Manure Products: ANMANURE.GEN, and related Risk Management Proposal for Processed Animal Manure Products: ANMANURE.GEN

The Poultry Industry Association of New Zealand (PIANZ), contactable at the address given at the end of this submission, represents almost all of the poultry processing companies in New Zealand, being companies that produce 99% of all chicken processed in New Zealand.

PIANZ's comments on the Draft IHS are presented below:

- PIANZ is very concerned that the processing controls suggested in the Draft IHS are weakened by the inability to fully control the composting process and, subsequently, to accurately measure temperatures within a composting process.

  The assumptions in the Draft IHS are that the required temperature for the required time, i.e. 80°C for 72 hours (3 days), can be verified by placing a Critical Control Point (CCP) sensor in one part of the compost pile, and that the required time and temperature result will be delivered on every occasion as per in a controlled oven or heating vessel.

  However, the Draft IHS requirement for the temperature to be measured near the top of the pile at one CCP and to reach 80ºC for 72 hours is supported only by the statement: "*because of the enclosed design of the tunnels it can be **expected*** [our bolding] *that the temperature in the remainder/other sections of the compost would be similar to or greater than that generated in the bottom section.*" (Draft Risk Management Proposal for Processed Animal Manure Products, Appendix 1, clause 8.)

The information supplied by the overseas processing company does not prove that the temperature actually reaches 80ºC. Furthermore, it is noted that a temperature higher than 80ºC is detrimental to the end product. This is an extremely fine balance to meet and PIANZ questions whether it is achievable.

Furthermore, the temperature differences seen in composting processes vary from batch to batch, and in different parts of the composting pile, as composting processes are inherently different for each batch; these differences in composting deliver different temperatures within the compost stack. The Draft IHS states however that the temperature required (80ºC) can be measured by **a** [our bolding] CCP sensor placed within the compost near the top of the pile for no less than 72 hours (3 days). The Draft IHS as written accepts that temperatures lower than 80ºC will be present in parts of the compost stack for the required period and are acceptable. PIANZ does not agree.

Information from Plant & Food Research submitted to MPI by Meadow Mushrooms on trials of temperatures in a similar composting programme demonstrates however that the composting process does not reach and maintain the required 80ºC for the required period. This is due to areas within the compost pile that will not /do not reach the temperature and time required by the Draft IHS.

Given the inability to accurately control composting and to measure and monitor temperatures within a compost pile, PIANZ's view is that the

Draft IHS will NOT deliver the risk mitigation expected.

- PIANZ is also concerned that the composted product will not be able to retain its acquired lower risk status due to the risk of cross-contamination. The compost is produced on an industrial site and the risk analysis does not supply any information as to how the manufacturers will maintain separation between processed and unprocessed compost products.

  Common machinery/persons/ equipment, for example, may have access to both the pre- and post-treatment areas of the site with consequent risks of cross-contamination. This risk aspect is not addressed in the Draft IHS document, nor does the manufacturer supply any information as to how contamination issues are detected or monitored. This is an issue of considerable significance: it is impossible, for instance, to clean forklifts that are used in the task of catching meat chickens to a standard of decontamination that eliminates *Campylobacter,* not to mention more robust organisms such as Infectious Bursal Disease virus.

  Further, PIANZ has a concern that many weed seeds may remain viable through the composting process described in the Draft IHS; other organisations will be submitting more fully on this point.

  PIANZ is also concerned that this product was imported on information supplied by the exporting plant. It is noted that MPI is still investigating the information that was originally provided on the compost ingredients (animal manure was excluded from the ingredients list), which led to many tonnes being imported over several months until supplies were suspended to allow the risk analysis process to be completed. If MPI is now relying on information supplied by the same source for the risk analysis, a higher degree of scrutiny of this information should be the default position.

  In summary, PIANZ is concerned that the process control of composting outlined in the Draft IHS and the risks for cross-contamination of the product are unmanageable. They do not give confidence that the Draft

IHS addresses the risks inherent in the imported product.

PIANZ is willing to discuss the concerns raised in this letter with MPI.

Yours sincerely

Kerry Mulqueen

Kerry Mulqueen
Senior Executive Officer, Technical
Poultry Industry Association of New Zealand, Inc.

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File: G/PIANZ/letters and faxes 2017

Niki Wright

Out of Scope [redacted]

From: Brandi Dixon s 9(2)(a) [redacted]
Sent: Wednesday, 8 February 2017 12:37 p.m.
To: Plant Imports <PlantImports@mpi.govt.nz>
Subject: Import Health Standard: Phase 3 Mushroom Growing Medium

The Te Mata Mushroom Company Limited
174 Brookvale Road
Havelock North
06 8777 266

Michael Whittaker, Director

The Te Mata Mushroom Company (TTMC) is New Zealand's second largest mushroom grower producing over 20 tonnes of mushrooms each week. Founded in 1967, we will celebrate our 50th anniversary this year and employ over 120 staff in our Havelock North farm. The farm is fully integrated with composting, growing and packing facilities contained onsite. The June 2016 Regional Economic Assessment Report indicated that TTMC generated economic impact gains for the Hawke's Bay region of $18.61 million total revenue; $4.45 million net household income; employment impact of 200 persons (including contracted service providers) and $7.19 million gross regional product.

We object to the importation of Phase 3 Mushroom Compost into New Zealand on the following grounds:

1. Effective control of *T. aggressivum* and MVX requires a stringent multi-system approach across the entire composting facility and throughout the full life-cycle of each batch of compost from phase 1 through to phase 3. Failure, or partial failure, in any part of this system – incomplete pasteurisation, failures in any of the hygiene measures, human or technical failures – may lead to contamination of multiple compost shipments.

2. The ongoing research into control methods for *T. aggressivum* and MVX within the European mushroom industry, and the continued incidence of *T. aggressivum* outbreaks indicates that, despite the measures currently in place, failures do occur and current control methods are not fool-proof. Until such methods are improved, it would be imprudent to risk the introduction of these organisms to New Zealand.

3. The ability to test for the presence of *T. aggressivum* and MVX is currently difficult within a compost medium. The most effective method for detecting *T. aggressivum* requires a pure culture for evaluation using the quantitative polymerase chain reaction method (qPCR), unfortunately this method is not effective with compost samples. MVX is a not a single virus, but rather a "syndrome" with a number of potential viruses, some of which currently cannot be tested for. Again, ongoing research is being undertaken in the EU mushroom industry to determine more effective ways to detect these organisms and until such methods are improved, it would be imprudent to risk the introduction of these organisms to New Zealand.

4. The IHS contains post clearance conditions for the importer to help identify and prevent the spread of the organisms if detected. However, should these self-regulated measures fail, or fail to be reported and/or contained in a timely fashion, the potential for spread of the organisms throughout the wider environment and to other mushroom farms is unacceptably high. The fact that symptoms of *T. aggressivum* may not

show up in the first two flushes is of particular concern as potentially tonnes of infected mushrooms, their packaging and the clothing of packing staff will have already left the facility before the infection is identified. In addition, it can be assumed that all staff – growing room, packhouse, and administrative - will share common lunch room and toilet facilities, two areas that have been identified as key locations for the detection and transference / reinfection of *T. aggressivum* but fall outside of critical operational control points provided by the IHS.

5. Such a failure could easily result in the movement of the organisms from the importing facility even before a positive onsite test. A large number of interactions occur with farms daily from deliveries of raw compost materials (or phase 3 shipments), packaging materials and consumables; to shipments of outgoing packaged mushrooms and spent compost; and movements of workers and contractors to and from the facility. While there is minimal physical interaction between farms in most cases, the spread of *T. aggressivum* and MVX throughout the UK and EU – in the case of *T. aggressivum* very rapidly through the later part of the 1980's and the 1990's - strongly indicates that these organisms can and do travel well in the event of any failure or delay in the identification and/or containment process.

6. Should such a failure occur, facilities and systems to contain any outbreak of *T. aggressivum* or MVX within many New Zealand mushroom farms are extremely limited due to the present style of composting and growing facilities – the majority of which comprise unenclosed or semi-enclosed compost handling areas and open air movements of growing trays. Should infected matter be introduced to this type of environment, full sterilisation would be extremely difficult to achieve and significant crop losses, business disruption and/or closure would result. Of particular concern is the sale / distribution of spent compost by farms that do not have the ability to effectively pasteurise the material before leaving the facility. While hygiene measures are in place in all farms, the incidence of outbreaks of existing *Trichoderma* species indicates clearly that these hygiene methods are not infallible.

7. Until recently, all of the compost used by New Zealand mushroom farms has been produced in New Zealand – from the smallest to the largest mushroom farming operations. All of the components required for composting are readily available within New Zealand. Compost production methods within New Zealand farms are on par with best practice internationally. There is no significant benefit to the New Zealand mushroom industry – economically, quality-based, or production orientated – to import phase 3 compost.

8. The biosecurity and economic risks to the New Zealand mushroom industry of introducing *T. aggressivum* and/or MVX to New Zealand via phase 3 compost imports vastly outweighs any perceived benefit to importing the material. We can see no justification for the process and oppose the introduction of such shipments.

The Te Mata Mushroom Company
PO Box 8137, Havelock North 4157

Niki Wright

Out of Scope [redacted]

From: Joost van Schipstal s 9(2)(a) [redacted]
Sent: Tuesday, 7 February 2017 1:38 a.m.
To: Plant Imports <PlantImports@mpi.govt.nz>
Subject: FW: Submission: Draft for Phase 3 Mushroom Growing Medium

Dear,

Regarding the draft for Phase 3 Mushroom Growing Medium we want to submit as follow:

Right address:
Walkro Blitterswijck BV, Veerweg 11, 5863 AR BLITTERSWIJCK, The Netherlands

At point 2.4.2. (2) a) i)
"steaming phase 2 and 3 production tunnels at minimum of either 60°C for 12 hours, or 65°C for 8 hours between each batch;"

to change in:
"steaming phase 3 production tunnels at a minimum of either 60°C for 12 hours, or 65°C for 8 hours before filling of spawned phase 2 compost in this tunnel;"

We hope you will adopt our recommendations, if you need more information feel free to contact us.

Kind Regards,

Walkro
Joost van Schipstal
Sales & Marketing Director

Mobiel: s 9(2)(a) [redacted]
www.walkro.nl
s 9(2)(a) [redacted]