

## Strategic Mushroom Pest and Disease Management Downunder

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**Abstract:** The Australian mushroom industry has had to take control of its own destiny with respect to pest and disease management. This has been necessitated by the demise of traditional service providers such as state departments of agriculture, universities and private consultants. This paper describes the strategies and services the industry has implemented through the Australian Mushroom Growers Association (AMGA) to meet the pest and disease management needs of growers and other stakeholders in the industry. The strategic issues that are covered include: the vision, planning, global liaison, communication / representation, mushroom PR / marketing and the industry management structure that has emerged to enable the industry to deal with a wide range of pest and disease issues. The services described include: AMGA Pest and Disease Management Service (Agora, R&D, grower and manager skills training, strategic reporting; AMGA QA/Food Safety Service; AMGA/Sydney University Marsh Lawson Mushroom Research Unit; and scientist training development. The paper concludes that industry risk management strategies will demand that industry leaders take action that ensures their industry is adequately resourced and managed with respect to pest and disease threats at the national, regional and individual grower level. The "so far successful" AMGA pest and disease management model described may be useful for mushroom industry leaders in countries that are suffering a decline in government-sponsored services. However, there is much work to be done over the next decade if the pest and disease services developed are to become sustainable. Work needs to accelerate soon if the goal is to be achieved.

**Key words:** Mushroom pests and diseases, management, Australian Mushroom Growers Association

### 1 Introduction

The days of dedicated research and extension staff, facilities, and programs supporting the Australian mushroom industry are but fond memories. In these halcyon days of industry support, mushroom growers received free or heavily subsidized services from State Departments of Agriculture, Universities and private consultants. These services included farm visits from technical experts, diagnostic services, industry databases for a range of topics, government funded R&D facilities and government funded R&D projects.

Over the past two decades in Australia, governments of all persuasions and jurisdictions have continually reduced the resources invested in agriculture and all the services referred to above have gradually disappeared over this period. The closure of NSW Agriculture's BCRI mushroom unit at Rydalmere in Sydney in 1996 highlighted the demise of pest and disease management support services for the Australian mushroom industry. Australian mushroom growers responded to these changed circumstances over the last five years by working together via the Australian Mushroom Growers Association (AMGA) to strategically rebuild the essential pest and disease capabilities and support services that their modern-day industry required. They developed an industry structure that ensures the resources are well managed strategically and a range of services that have been designed to meet the needs of growers and other stakeholders inside and outside the industry. Allan and Clift,<sup>[1]</sup> Fletcher *et al.*,<sup>[2]</sup> Warren *et al.*,<sup>[3]</sup> and Seymour *et al.*,<sup>[4]</sup> describe the development and services in more detail. This paper describes the Australian industry's response and the lessons that have been learnt along the way.

## 2 Materials and Methods

### 2.1 Strategic issues

In 1999 the AMGA Board identified interrelated risks for the industry in food safety, pest and disease management, and pesticide access. They hosted an industry P&D strategic planning meeting to identify the key things the industry needed to do to meet its pest and disease management and pesticide access requirements. The group represented a range of stakeholders in the mushroom industry (except government) and they nominated the following key areas as essential: pest and disease diagnostic support for growers; a pest and disease "intelligence" system for the industry; an electronic pest and disease reference library; a pesticide use/ registration research facility; and pest and disease management training for farm managers and key staff. The group also acknowledged the relationship of the key areas with industry food safety systems, and the importance of human resource development in all of the technical disciplines covered.

The vision for the initiative was to have an industry controlled range of services that delivered real world solutions to the on-farm problems of growers; to provide industry with meaningful data to monitor industry risk and take action where necessary; and to generate data that would underpin PR and marketing initiatives, and representations to governments and NGOs. The Board acknowledged the need to develop a global approach to resource development in these areas.

A technical taskforce was created to develop an operational plan that would deliver the strategic outcomes identified by the industry and report to AMGA Board. Subsequently, management committees have been established for the AMGA's Pest and Disease Management Service (PDMS) and the Marsh Lawson Mushroom Research Unit (MLMRU). AMGA also retains a food safety expert to manage the industry's food service program. The AMGA's General Manager oversees all activities and budgets.

### 2.2 Services

#### 2.2.1 AMGA's Pest and Disease Management Service (PDMS)

PDMS is Australian industry's key entity for providing pest and disease management services to growers. There are several key components to the service. Agora is a web-based diagnostic service for growers. It also provides P&D management support via consultants, an electronic P&D library, a database for individual farms, and a database of all pest and disease activity in the system. This latter database is used for strategic decision making by industry through AMGA.

PDMS also commissions or undertakes small-scale applied R&D projects in response to issues and problems that emerge from time to time from the operation of the service. Disinfectant efficacy trials and industry surveys on pesticide usage etc have been undertaken in recent times.

PDMS is also involved in pest and disease management training. Education/training needs of growers and managers are identified through PDMS operations. Private training companies are then retained to deliver appropriate courses around Australia.

PDMS consultants also write a column on topical pest and disease matters for publication in the AMGA Journal each quarter. This helps keep pest and disease management "top of mind" for growers and also maintains a profile for PDMS.

The PDMS industry database and reports from the Service's consultants are combined every six months to provide a strategic report for the AMGA Board and the industry. A strategic review of the pest and disease status of the industry and the operation of PDMS is undertaken annually.

#### 2.2.2 AMGA/Sydney University Marsh Lawson Mushroom Research Unit

Two experimental rooms at Sydney University, each holding up to 1.5 tonnes of compost, have been recently refurbished. Each room has independent controls for temperature, humidity and CO<sub>2</sub>, with chilled water for cooling. Each room has its own humidification system. There is a separate steam boiler so the rooms can be cooked out to maintain hygiene.

The unit's current focus is the establishment of residue and efficacy data to support registration or permit applications for pesticides and their use patterns for the mushroom industry. Experiments completed to date include: diazinon as a casing treatment, Octave® applied as a split application, cyromazine (an insect growth regulator available in North America) as a Phase I compost treatment and Pestigas® as a space spray inside growing rooms.

The next series of experiments currently underway is evaluating possible degradation of pesticides by hypochlorite and/or chlorine dioxide; and evaluating replacement fungicides for benomyl. There are two candidates, Topsin®, which is thiophenate-methyl and carbendazim (available as Howzat® and as Spin®). Three use patterns will be assessed: spawn treatment, incorporation into casing, and watering on in two split applications. *Trichoderma* will be the main target for these fungicides, but activity against other fungal pathogens will also be determined.

The Unit expects to be granted Codex GLP accreditation in the near future. This level of accreditation has been sought to enable the Unit to participate in global pesticide research programs and international scientific and student exchanges.

#### 2.2.3 AMGA QA/Food Safety Service

AMGA's QA/Food Safety Service supports growers with the planning, operation and administration of their on-farm QA/food safety systems. The Service arranges verification testing for participants in September each year and retains a QA/Food Safety consultant to undertake an annual review of each farm's system as part of its annual accreditation process. The consultant also provides advice to the AMGA on the most cost effective way for farms to minimize the risk of a food safety problem.

The confidential individual farm data generated through the Service is amalgamated to provide information for industry risk management and strategic decision-making. The collective data is also used to generate publicity statements on the safety of mushrooms as a food product for use in the industry's PR and marketing programs. This service is likely to be expanded to include environmental assurance in the near future.

### 2.3 Scientist training development

The industry has recognized the need to encourage young scientists to develop skills in mushroom science. Because the MLMRU is located in a university, it enables student projects to be undertaken in addition to the formally funded work program. The industry intends to further develop PhD and other student training programs in conjunction with the university. Exchange programs with international scientists and students are envisaged.

## 3 Results

### 3.1 Strategic issues

In a relatively short time the industry has come a long way in reestablishing a pest and disease management capability for itself. An infrastructure has been developed for all facets of the vision however there are still

many challenges to meet in operational aspects and ongoing development. The need for a global approach is becoming more obvious every day.

### 3.2 Services

#### 3.2.1 AMGA's Pest and Disease Management Service

PDMS has become an effective focal point for pest and disease issues. However responses to the various services has been interesting and not always according to plan.

Membership of Agora has remained relatively static since it launched in October 2003. Only about 30% of growers are members but interestingly these people represent over 80% of production. Initial expectations were that over 70% of growers would be Agora members by now. A survey of those people using the system indicates that they value the resource highly and will continue to use the system regularly.

Diagnosis requests through Agora have not reached the level expected. There has been more contact with the experts over the phone seeking advice than via the internet.

Visits to the knowledgebase (electronic library) have exceeded expectations - it is by far the most valued facet of Agora with users.

The databases have had limited value because the volume of data generated has not been large enough to provide any meaningful advice. PDMS will undertake a major industry survey canvassing a range of pest and disease issues in early 2005. This will be used by PDMS to provide information for the industry's 2006 -2011 strategic plan.

Demand for PDMS grower training has been firm and is ongoing. Two sessions were conducted in 2005 in Adelaide and Brisbane. Two more are planned in 2005. Farm principals have indicated a positive impact on staff performance following training sessions.

#### 3.2.2 AMGA/Sydney University Marsh Lawson Mushroom Research Unit

Off-label use permits have been issued for Octave® and Pestigas®. Label applications have been lodged for Cyromazine and Diazinon. The facility is working well and the GLP accreditation preparation is progressing ahead of schedule. The MLMRU has provided industry with the ability to generate its own data and take responsibility for its own destiny. This has created enormous credibility with regulatory stakeholders and with governments in general.

#### 3.2.3 AMGA QA/Food Safety Service

This service has proved a great success with over 60% of growers using it (approx 90% of Australian mushrooms are grown under third party audited QA/HACCP food safety systems). The data generated by the Service is used in the industry's PR and marketing communications to advise that mushrooms are a very safe product.

### 3.3 Scientist training development

The development of scientists has got off to an encouraging start. During 2004, there was one PhD student, Afsheen Shamshad, working on managing both *Vorticillium* and mushroom flies; and an Honours Student, Iona Symons, working on fungal hosts and population dynamics of red pepper mites. Part of Afsheen's work was included in a presentation at the ISMS congress in Miami in March 2004. An enquiry has recently been received from another student interested in doing a PhD at the MLMRU in 2005.

## 4 Discussion

### 4.1 PDMS

Investigating the lower than expected Agora usage has been interesting. Casual discussions with Agora members indicate the initial reasons given by growers that led to the development of the Agora system remain valid so its quite strange that usage wasn't as high as expected.

Further anecdotal investigations indicate that disease pressure in the industry hasn't been severe in the last 12 months and hence the low level of diagnosis requests. However, an alternative explanation is that mushroom growers in Australia are not regular or comfortable internet users and this is deterring more regular usage.

Evidence for this view comes via a recent survey by the AMGA on preferred communication mode for AMGA members. This survey showed that, while more than 70% of growers have web/email capability, the vast majority still prefer phone or fax communication. Furthermore Agora members often ring to be reminded of their username and password to use the system.

While Agora usage levels have been lower than expected, the reasons for its development remain valid. As pest and disease pressure increases from time to time, IPM thresholds move closer to zero due to tougher economic conditions, and industry participants become more regular internet users, Agora usage levels are likely to increase. There has been some discussion about PDMS developing a disease monitoring service for farms on a regular basis to assist in lowering IPM thresholds and provide a quantitative tool for decision-making.

However, there is some concern that usage of the system will be highly variable in the short term and hence the quality of data for decision-making may be unsatisfactory. The current practice of telephone surveys to determine strategic information for pest and disease matters will continue until system usage is high enough to ensure the database is a reliable source of information.

The success of Agora's Knowledgebase (electronic library) has resulted in further information being added and a separate electronic library being established for other aspects of mushroom production on the AMGA's member website.

### 4.2 MLMRU

The Unit is performing well. It has been designed as a "dirty unit" (pests and diseases can be safely introduced into the growing rooms to test efficacy of pesticides and then cleaned out thoroughly at the completion of the trial) and following Codex GLP accreditation will be seeking global connections in the search for new pesticides suitable for mushrooms.

### 4.3 QA/Food safety

This service is performing well and will continue to gain members and assist new farms implement systems. Having an industry approach to QA and particularly, food safety, has been extremely beneficial in terms of bulk purchasing of services, representation to government and regulators, and in PR and Marketing programs. It has been enormously beneficial in the management of the industry's risk management plan

### 4.4 Scientist training development

The relationship between the industry and Sydney University via the MLMRU has worked well in providing opportunities for young scientists to be exposed to mushrooms and the industry during their training.

However, industry will need to foster these scientists otherwise they will move to greener employment pastures

when they graduate.

The whole pest and disease infrastructure in Australia is dependent on having appropriately trained and competent scientists to maintain and improve the services established by the industry. There is a significant "graying" of this resource and there are very few prospective mushroom scientists coming through the ranks. Attracting young people with appropriate skills into agricultural sciences is proving extremely difficult in Australia. The mushroom industry will need to be creative and proactive if we want to attract this scarce resource to our industry.

With the continuing rationalization of a relatively small industry in Australia (five companies grow 60% of the mushrooms) the opportunity for future employment within the industry is limited. Employment in research institutions is also limited by ongoing reductions in core funding. It is unlikely the Australian industry will be able to maintain a fully resourced scientific support system and will need to be involved in a global approach to solving this problem.

It is estimated that the industry has about ten years to put a sustainable solution in place. It will need to accelerate its initiatives in this area or the risk to industry of a pest and disease catastrophe may exceed acceptable levels.

## 5 Conclusion

The Australian mushroom industry has reestablished a pest and disease infrastructure that can protect and support the continuing development of the industry over the next decade or so.

Although some services are being underutilized at the current time it would appear that circumstances and users are likely to change in the future and this will increase demand.

However, for the system to remain sustainable, the industry will need to be creative in the way it attracts appropriately trained scientists to the industry to maintain and develop the services it has developed.

Some of the issues the Australian industry will face are also likely to be experienced by other countries. The Australian industry is unlikely to have the resources to meet these challenges on its own so it will be essential to take a global approach to investing its resources and participating in solving the problems.

The industry has about a decade to have a sustainable pest and disease service model in place but current and new initiatives will need to be accelerated if the goal is to be achieved.

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