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Fumigation — what lies ahead?

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Abstract. There are several important drivers currently affecting fumigation practice, including the Montreal Protocol, efforts to improve the working environment, rising insurance premiums and the development of resistance to fumigants by pest species. Environmental issues, occupational health and safety, and quarantine needs are all vitally important. Against this background, this paper considers the fumigants available, or soon to be available, and hazards some predictions about likely future directions in fumigation practice.

Introduction

Most fumigation practices have undergone very few changes in the past half-century, with little advancement of the technology. Additionally, an unhealthy degree of comfort has been reached by fumigators in handling their tools of trade, including the fumigants they use.

At Nordiko we have made it our goal to effect changes in fumigation practices, so as to make the business more standardised and accountable.

To answer the obvious question 'Why are we doing this?' I will to deal with four key areas where we believe change is needed:

- the environment
- occupational health and safety (OH&S) needs
- the Montreal Protocol
- use of available technology.

We'll start by looking at the drivers for change, and in particular the Montreal Protocol which for quarantine and pre-shipment treatments (QPS) started the wake-up call.

Drivers for change

- **The Montreal Protocol** challenged the problem of continuing to allow ozone-depleting substances to escape into the atmosphere. The Protocol, signed by a large number of countries, saw substantial changes to our daily lives with the banning of CFCs, HCFCs and halons—compounds in everyday use refrigerators, air conditioners, aerosols etc. It also uncovered the damage caused by methyl bromide, a gas widely used in fumigation in both pre-planting and postharvest operations. Work to find alternative pre-planting procedures has continued, with some success (although the Californian strawberry farmers might disagree with that statement), but there has been less success in finding postharvest solutions, particularly in QPS.
- **Increased insurance premiums** have helped reinforce the issues of safer working practices as we find ourselves in a post 11 September insurance environment in which some activities either cannot be insured or cannot be insured at a commercially acceptable cost. Fumigation companies are finding suitable insurance for their activities both expensive and hard to secure.
- **Better working practices** are a product of a strong focus by government in enforcing employers to provide a safe workplace. Backed up by heavy penalties for offenders, and the possibility of business-crippling litigation in the case of employee death or injury through negligence, the working environment has been under constant scrutiny in recent years. The fact that legislation leaves the onus on company directors to ensure they provide a safe workplace, without necessarily prescribing the exact steps and procedures on a case-by-case basis, makes the process risky and difficult to assess.
- **Pest resistance** has become an issue in several products, often as a result of poor fumigation practices. Insufficient dosage or too short a fumigation period can result in pests building resistance to fumigants. Some concerns have been expressed with potential phosphine resistance in grain pests. Also, there are several pest species that are showing resistance to heat and cold treatments.
- The Indian experience in trialling **biological control** may see this form of pest control used instead of pesticides in areas where the use of pesticides is far enough away from the biologically controlled area. The difficulty in biological control is establishing the natural predators in sufficient numbers to be effective in preventing major crop damage. The risk of losing substantial crop volumes in the first and possibly second season is a potential cost. Where control by genetic modification or pesticides fails, biological control may

be the sole alternative. Will we see the pest controller of the future using biological control as a tool, as well as pesticides? We believe that is quite possible.

Environment

- In most fumigations, the fumigant gas is vented to the atmosphere at the end of the fumigation period. Legislation is starting to catch up with this process, particularly in California. More recently, legislation was passed in the State of Victoria prohibiting the venting of toxic gases where recovery is possible. In both places, the legislation applies generally rather than being specifically aimed at ozone-depleting gases such as methyl bromide. Considering that many fumigation areas are located close to major city populations and to work places this trend is likely to continue. There is thus a rapidly growing need for suitable recapture processes.
- The Kyoto Protocol covering emissions of greenhouse gases followed close on the heels of the Montreal Protocol. There are two significant signatories missing from this protocol to date: the USA and Australia. Both countries have issues relating to the use of coal as a fuel in power stations, and both countries have relatively cheap fuel for automobiles and very powerful road transport lobbies. The success of the Montreal Protocol as a first global treaty on the environment is therefore seen as paramount to the work being done in getting similar signatories to the Kyoto Protocol and any future treaties dealing with the protection of the global environment.
- Any new gas to replace methyl bromide has several hurdles to overcome, not the least of which is the environmental one. Firstly, it cannot be an ozone-depleting substance. However, in view of the concerns about any toxic emissions to the atmosphere, any new gas will be more likely to be registered speedily if it comes with a guarantee that only minimal emissions will be vented to atmosphere. We see scrubbing technology as being an important ingredient in this process. Furthermore, the application must be cost effective. An expensive and elaborate system will hinder the process as there is always resistance to any substantial increases in the cost structure in the export chain.

Quarantine needs

- Many goods imported into Australia (and indeed into many other countries) face fumigation, not because of the goods themselves, but for the timber packing they come in. In many cases, fumigation is carried out (and paid for by the importer) before shipment, but often this is not effective and fumigation is re-ordered once the shipment reaches port in Australia. An accountable, standardised fumigation process could solve this double fumigation problem. We are working with the Australian Quarantine and Inspection Service on trialling this in trade between India and Australia. The importer benefits by a quicker turnaround of the goods in Australia and through saving the cost of a second fumigation.
- In making this process accountable, we will provide data collected during the fumigation, providing critical information such as gas concentrations at the start and the end of fumigation (and periods in between as desired) and time under fumigation. Other data, such as temperature and humidity, can also be made available. Accurate gas dosage is critical in any fumigation process, to ensure the pests or pathogens are killed and not given a non-fatal dose allowing immunity to build.
- Once the process as per our intended Indian trial is established we plan to have this information downloaded to our website, giving quarantine authorities the ability to look up any imported container and see its fumigation history. It is not hard to imagine how much the supply chain can be accelerated by having accurate information available before the arrival of the goods at their destination. It also helps free-up valuable quarantine resources for other purposes.

Fumigants

- What is the future for methyl bromide? The use of methyl bromide as a QPS fumigant is currently exempt from the Montreal Protocol, although the Europeans are trying hard to get either a restriction placed on the amount used for QPS or even a total ban. Developing countries have another 12 years for the phase-out for all usages, but we can expect pressure to grow to bring that deadline forward once the phase-out has been effected in the rest of the world. However, until a suitable replacement product is found and accepted by quarantine authorities, methyl bromide will continue to play an important role in border protection. Limits on production of the gas, and import restrictions by governments, are the most likely forms of control we will see. There will be some non QPS ‘critical use exemptions’, but these will be issued annually and therefore pressure will be mounted for alternatives to be adopted in such cases. Recapture of spent fumigant is a way of at least restricting emissions during these processes.
- As to alternative fumigants and processes, there are some positive signs:
  - Carbonyl sulfide (COS), being assessed by CSIRO, has good potential in many pre-shipment applications, but not all inbound quarantine applications as it does not kill seeds.
  - Cyanogen, also being trialled by CSIRO, shows possibly the best potential for quarantine purposes. We have no doubt you will hear more of this gas in the near future.

– Sulfuryl fluoride/Profume™ looked like a gas with potential to replace methyl bromide but has run into objections in the USA because it may upset the fluoride balance in the food chain.
– Irradiation has attracted stronger interest of late, but the start-up costs for its application are very high.
– Heat/cold and CO_2 treatments are being used successfully in shipments of fresh produce, and cold treatment is showing some success for in transit applications.

In the longer term, it is likely that where methyl bromide was once seen as a single treatment for QPS purposes, future treatments will be broken down into a range of these options, including methyl bromide, until an acceptable substitute is found.

OH&S

Entrenched bad habits in fumigation will need to change in Australia as Commonwealth and State governments introduce more stringent OH&S legislation to protect people in the workplace. Exposing the fumigators themselves and fellow workers to dangerous doses of toxic gases should no longer be unavoidable when suitable containment and recapture processes are used.

We have recently discovered that a hidden hazard is emerging as a major OH&S issue in container shipments. Imported containers, fumigated overseas, are being found to have higher than acceptable threshold levels of gas in them. Australian Customs and some of the multinationals have already recognised this problem, and Customs now use gas extraction equipment on all containers before they allow their staff to enter them. We have just started a testing program and while it is too early to generalise, the initial results are showing residual gas levels from 20 to 500 times the threshold limit value in some containers we have tested. One of the problems has been finding a suitable device to accurately measure these gas levels. Some monitors on the market show gas concentrations, but they need to be regularly calibrated to ensure accuracy, a practice we believe is not undertaken sufficiently to guarantee correct readings. Recent studies conducted in the port of Felixstowe in the UK and in Holland have confirmed our suspicions on residual container gases.

Conclusion

It is likely that the days of fumigation under tarpaulins will soon be a feature of the past. Future fumigation will be undertaken in either suitable gastight chambers or using clip-on container systems. They will also be more stringently monitored for gas concentrations and have the residual gas captured at the end of the process. The technology to do this is already available, and the only barrier to implementation is getting the message across to the industry with some support from governments.

Border protection will remain a priority in these days of lower global trade barriers and increased international trade. A recent infestation of Asian longhorned beetle in USA is a reminder that global trade also brings unwanted pests. Until a suitable replacement quarantine treatment is found, our best efforts are needed to use methyl bromide with care, for the sake of the environment.

The future of pest control lies in the application of integrated pest management systems focusing first on prevention of the spread of pests by controlling natural breeding conditions. This will be followed by measured use of either pesticides or biological applications to manage pests according to region and need.

Indeed, the pest controller of the future will probably need a science degree.