TECHNICAL

NURSERY PAPERS

June 2015 Issue no.5

Jump to page
1 2 3 4

The use of gas in nursery management

In this month's Nursery Paper NGISA CEO, Grant Dalwood, reviews the use of gas within nursery production.

The use of gas in nursery management

The various types of environments encountered within the nursery sector vary greatly from full sun outdoor to climatically controlled indoor environments. Subsequently the need to control all types of factors within the range of applications will also vary. Gasses in various forms have been used for many years to control, treat and fumigate all types of problems occurring. This paper is aimed at updating knowledge within the industry and perhaps opening aspects of control that have been over looked for many years and due to new pest and insect incursions.

Gas is one of the four fundamental states of matter (the others being solid, liquid, and plasma). What distinguishes a gas from liquids and solids is the vast separation of the individual gas particles. This separation usually makes a colourless gas invisible to the human observer.

Because most gases are difficult to observe directly, they are described through the use of four characteristics: pressure, volume, number of particles and temperature. Pressure and temperature influence the particles within a certain volume. Gas particles spread apart or diffuse in order to homogeneously distribute themselves throughout any container.

Natural gas

Natural Gas in Australia is well known as an efficient form of energy with widespread availability. The two main types of distribution of gas for use as a nursery energy system are tank (including bottle) and mains supply. As many nursery production facilities are in peri urban areas often a continuous permanent mains supply is not available and subsequently tanks are required to store the liquefied natural gas product that is used. It is always advisable to thoroughly research and compare the various costing differentials between the energy resources available in your local area. The costs of running tank fed machinery can be very high if controls are not put into place at setup.

All gas tanks require a licence from the local authority in order to store product on site as well as ensuring sufficient segregation from other structures. Registration of a tank is reliably conducted through the supplier and recharging of bottles and tanks is generally conducted through the supplier as well.

With ever changing cost structures and tariff rates the Nursery industry operator needs to regularly look at their onsite needs. This may result in the usage of a number of forms of energy sources such as electricity, gas, wind and solar, as the availability and costs of these sources develop and the needs of the business operator change. For example the use of electrically powered under bench heater cables may become inefficient and subsequently obsolete if gas can be efficiently used to heat water that can be channelled to a number of parts of a facility effectively to do the same job.

The use of Methyl Bromide gas as a soil fumigant was widespread in Australia for many years and has now been systematically abolished under the 2005 Montreal Protocol, due to its effects on the critical ozone layer of the earth's atmosphere. Alternatives to this very effective but environmentally damaging gas have been developed but many do not have the same breadth of efficacy, i.e. they are effective on some but not all vectors that Methyl Bromide controls, as it is a soil steriliser as well as a controller of insects including nematodes.

Australian Standards for potting media, composts and soils have influenced the quality of media in the industry and subsequently the need for media sterilisation is minimal. Indeed in Nursery best practice, one area that still utilises Methyl Bromide is for Strawberry runner production.

There is scope within the NIASA program to recycle potting media as long as it is sterilised, this process if required is

A sulphur diffuser hung at the correct height and aided with fan dispersal over a gerbera crop

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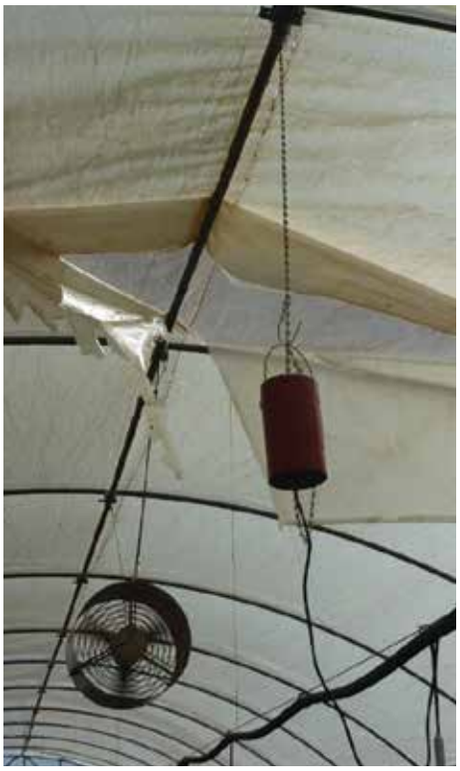
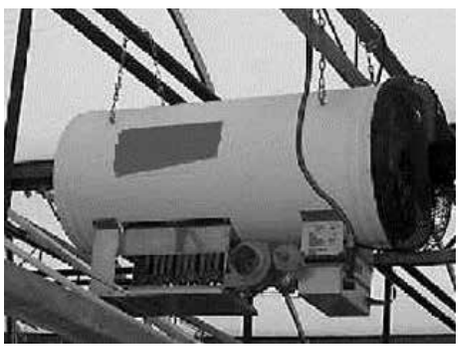


A sulphur diffuser hung at an incorrect height and aided with fan dispersal but destroying the plastic covering above as it is too close.

often carried out by the use of steam generated by various forms of energy. Steam sterilisation is extremely effective and relatively safe given good quality units and a regular maintenance program. Work, Health and Safety considerations along with good training are mandatory when using all types of steam sterilisers. The age of steam sterilisers certainly can impact upon their safety and effectiveness. Likewise all due care must be taken with properly conducted in accordance with state regulations.

Sulphur dispersers are a commonly used method of control for a range of greenhouse or glass house problems. These units consist of sulphur powder contained in an aluminium pot under an electrical element enclosed within a stainless steel cover. The sulphur vaporisers to create a gas vapour that spreads with the aid of fans to protect crops from fungal diseases such as Mildew, Botrytis and Black Spot. The usage of these effective and efficient diffusers is widespread within a number of scenarios as fungal spores cannot spread in the sulphurous atmosphere. The units also inhibit the spread of greenhouse pests such as spider mite.

One of the problems with these dispersers is the need to ensure that the consistent heat generated (temperature regulation at about 150 degrees Celsius) by the diffuser does not burn the sulphur and produce oxides but creates a vapour that is dispersed over the crop and throughout the growing house. Also the location of the vapouriser in relation to the height of the crop is often a variable due to overhead watering causing water to settle in the sulphur pan and altering the effectiveness of the diffusion. Aligned to this is when diffusers are put too close to the plastic cover of a poly tunnel then burning of the plastic lining occurs and a rapid breaking down of the poly skin. Coverage of sulphur units is regulated by airflow distribution and through the natural funnel effect created by the shape of the lower pan. Each diffuser is capable of treating at least 100m^2 depending on the size of the house, severity of fungal problems and airflow.



A Co2 Generator – often attached to fluting for better distribution through a house (Source - Ontario MAFR)

Micro climates within various growing structures can vary, the levels of light, temperature, water, air movement, humidity and air quality are all factors that affect plant growth. One of the factors that can be controlled by augmenting gases and has been used for a number of years within the industry across the globe is the addition of Carbon Dioxide (CO2). The theory behind the process is that the CO2 when raised from ambient sea level (app 340ppm) to a level of around 1000 to 1300 ppm in the airspace of a growing house will aid photosynthesis. Photosynthesis is a process which uses light energy to convert CO2 and water into sugars. Many crops have shown that for any given level of increasing the CO2 level to 1,000 ppm plus will increase the photosynthesis by about 50% over ambient CO2 levels. Light levels are also an important factor in the equation of adding CO2 to ambient air, to achieve best results the addition of CO2 is only effective during light hours. Growers could regard CO2 as a nutrient similar to fertilisers and water. Another factor to consider in the design of a growing house is that it is important not to let the ambient level of CO2 in the air drop below the 340ppm level as this will have a detrimental effect. It is therefore essential to have good natural air flow within enclosed structures.

Measuring equipment for CO2 levels are readily available to incorporate into a basic recording program for nursery production systems. There are a number of providers who can assist in developing a recording system for greenhouse growing and they should be consulted in any system investment.

Fogging systems can vary depending on the volume, number of particles, pressure and temperature involved in the process of dispersal of a liquid through the fogger nozzles. They are an often forgotten aid in creating not only a better growing atmosphere but also the effective method of dispersal of an array of materials in order to achieve a desired result. A limitation of fogging will be the final particle size that can be squeezed through the nozzle at pressure. This very process means that the liquids being used to carry the supplements being dispersed will need to have no impurities that will clog up nozzles. Water treatment will often be required as well as storage and collection through a dedicated line system devoid of contaminants.

Fogging systems and misting systems are often confused with each other as they are substantially the same, the difference being in the size of the droplet they produce. Misting systems typically operate between

Portable fogging machines can be utilised with various propellants to disperse fungicides and insecticides in green houses

An effective inline fogging system to control humidity in a propagation area with misters (hanging) at Native Plant Wholesale Nsry (BioSecure HACCP)

Bottle gas refilling station at Bio Gro SA (Biosecure HACCP)

100psi and 250psi, with droplet sizes of around 200 microns in size. High pressure fogging on the other hand, produce a droplet around 10 microns, (i.e. 10-20 times smaller than a misting system). Droplets from a high pressure fogging system are so fine that they are able to remain suspended in the air until they evaporate. Increased droplet size leads to poor evaporation, reduced greenhouse cooling effectiveness and increased wetness in the greenhouse .This wetness can cause increased disease, crop damage and pose a safety risk to greenhouse staff. Permanently installed foggers require high quality pipes and fittings to accept the pressure and give solid performance over many years, so don't scrimp on the setup costs.

In essence high pressure fogging, which operates at over 700psi, gives optimal greenhouse cooling and temperature control. Droplets flash evaporate, eliminating the chance for excess wetness to occur, as this process is happening in the area where the heat is, the cool air travels down to the crop level, to be replaced by the hot air rising. The convection air currents ensure even temperature distribution throughout the crop without the need for fans to stir and distribute the cooler air, thus saving energy. Because droplets fully evaporate high pressure fogging is often referred to as dry fog. One of the advantages of high pressure fogging is that it can be applied directly where the hot air is located.

Ideally humidity should be between 50% and 70% for optimum growing conditions, however much higher levels are achievable if required, such as in propagation areas.

A steam sterilising unit at Great Southern IT – WA (NIASA Accredited)

When heat levels rise, humidity levels drop, the plants under stress face double trouble, and it can be a deadly combination. High pressure fogging can provide almost immediate humidification, overcoming a potential huge loss in greenhouse stock. Accurate humidity and temperature control is essential throughout the stages of production, media should be moist, but without wetness. System Design Considerations must ensure that humidity levels do not drop below 30%. If more humidity is needed, the greenhouse's ventilation system can be turned off. Determining how often foggers should be on, as well as the amount of time between fogging events, depends on the desired level of relative humidity. In general, systems used to increase humidity run for a very short amount of time, with the duration of fogging ideally lasting 1 to 3 seconds. Fogging systems, be they portable or permanent are reducing in cost and they can be utilised in other very effective ways also to distribute fungicides and pesticides.

Dust is also a problem that can be controlled by high pressure fogging. The small droplets, produced make it effective in encapsulating dust particles, and bring these to ground without causing wetness.

Liquefied gases are a very important method for control in the pest and food industry where complete extermination of pests, rodents and insects are essential. Perhaps we can learn from them within the nursery sector and in alliance with our existing IPM (Integrated Pest Management) programs gas generated products could be used to augment the ever increasing resistance within nurseries of common flying insects that cause great product value decrease. One of the great beauties of the product is that when sprayed selectively it can be used outside directly onto crops on a calm day to eradicate many insects that are resistant, inside use is extremely effective for sheds and houses of all sizes.

Although seasonally variable, within any nursery there is often a need to control flying insects at the growing point as well as the despatch point.

Liquefied gas based pesticides can be used in this situation and are readily available, clean and easy to use. They are available in a range of options which can ensure effective control in a short space of time and with limited safety risk if used correctly. The chosen gas product will disperse over a large volume through a simple hand held gun attached to small easily mobile cylinders; application is simple and fast and can be carried out in some cases with people in a close proximity or with a vacancy period for other products. Like all pesticides, always read the product specifications and Safety Data Sheets (SDS). and one of the beauties of this type of product is it is regularly used in Food processing and storage warehouses, Domestic and commercial premises, hotels, restaurants and hospitals, Mushroom farms, Dairy product processing, Food storage and cut flowers throughout the world already so is well tried and tested.

Another use of gas is demonstrated in the use of a compressed air bench lifter to assist with the rotation of stock in a glass house (Jong's Nursery South Australia)

Further Information

Nursery paper 2001 Vol 5 *Water fogging and misting systems are they a risk to human health*?
Ontario Ministry of Agriculture Food and Rural Affairs *Carbon Dioxide In Greenhouses* Available online at http://www.omafra.gov.on.ca/english/crops/facts/00-077.htm

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