Agriculture and Respiratory Protection

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The agriculture workplace has long been known to be associated with respiratory disease. Respiratory disease is among the main chronic health conditions affecting farmers. Those at potential risk include farmers and families, agricultural workers, abattoir workers, greenhouse & nursery workers, veterinarians, and grain elevator workers. There are common exposures that can lead to respiratory illnesses, often with overlapping clinical signs and symptoms. Many agriculture activities create respiratory health hazards - examples of air contaminants include pesticide dusts, mists, or vapours; exposure to mouldy hay, and grain; hydrogen sulfide accumulations in manure pits and sump pumps; and many others.

INDUSTRY HAZARDS
Major respiratory hazards include:

Organic Dusts: Silos, dairy and poultry barns, and grain bins are sources of high levels of organic dusts. Organic dust is a complex mixture of vegetable matter, pollens, animal dander, insect, rodent and bird faeces, feathers, microorganisms, bacterial and fungal cell wall toxins, pesticides, and antibiotics. These components lead to an inflammatory response in the mucous membranes and respiratory tract or an immune response to allergens contained in the dust. Allergens include animal products, antibiotics and animal feed additives, pollens, storage mites, fungal and bacterial moulds, and protein components of grain dusts. Bacterial sources and fungal moulds are associated with sensitization leading to hypersensitivity pneumonitis. Allergic conditions can include upper airway allergic symptoms as well as asthma. High levels of dusts and moulds are associated with activities like unloading grain bins, and silo unloading and uncapping.

Inorganic Dusts: These are primarily an issue in field activities associated with ploughing, tilling, haying, and harvesting. The newer tractors and combines generally provide adequate respiratory protection because of the air filtration in enclosed cabs, but relies upon changing the filtration regularly. Grain handling, manual harvesting of tree fruit and grapes, potato harvesting, and small vegetable harvesting by hand can also cause an exposure to inorganic dusts.

Hydrogen Sulfide
Hydrogen sulfide (H2S) is a very toxic chemical asphyxiant and has a mechanism similar to cyanide. It is a by-product of rotting manure so any collection or build up of this can be source of odour, irritation or worse. Paralysis of the respiratory centre is the primary lethal toxic effect. H2S is heavier than air and colourless. It has a very low odour threshold, with an unpleasant “rotten egg” odour at 1-3 ppm. The toxic effects begin at 100-150 ppm with paralysis of the olfactory nerve and inability to detect the smell of H2S at higher toxic concentrations. Knockdown occurs at 500+ ppm and respiratory paralysis occurs at 500-1000 ppm. Generally, the concentrations in Australia and New Zealand agricultural environments are low levels and may cause eye or respiratory irritation. Cough, shortness of breath and chest pain can occur at irritant levels.

Ammonia
Ammonia (NH3) is another gas associated with manure. It is a pungent respiratory and mucous membrane irritant with a low odour threshold. It is lighter than air and causes respiratory inflammation. Ammonia is additive with the effects of dusts and can be carried further into the lungs by adsorbing onto respirable dust. Eye, nose, and throat irritation is common and higher concentrations result in cough and chest pain. In agriculture, ammonia does not exist as a single exposure agent but in combination with organic dusts and endotoxins and often results in sinusitis and chronic bronchitis after years of exposure.

Pesticides
Acute exposure to organophosphates or carbamates resulting in poisoning can result in pulmonary symptoms. This can occur in applicators, or in field workers entering a field before the safe re-entry interval guidelines. Excessive bronchial secretions and bronchoconstriction can cause acute respiratory distress, wheezing, chest pain and coughing. Cardiorespiratory arrest is the usual cause of death in acute poisoning.

Fumigants are gases or liquids used in interiors to kill pests in stored grain and sometimes injected into the soil in potato and grain production. These materials are rapidly absorbed through the lungs. Some may also penetrate skin and personal protective equipment. These include methyl bromide, ethylene oxide and phosphine. The interior of enclosures treated by fumigants can be extremely dangerous. Inhalation of toxic levels of fumigants are associated with respiratory irritation leading to pulmonary oedema and loss of lung function.

Disinfectants
Exposure to high concentrations of disinfectants such as chlorine gas, quaternary ammonium compounds, or mixing bleach with ammonia in poorly ventilated indoor settings may cause acute pulmonary irritation.

Dehorning/debudding
This process can release amounts of fine particulates, organic vapours and hydrogen cyanide, a lethal gas* Use of a respirator with suitable filters that can absorb these is advised (e.g. 3M 6057 A1B1E1 cartridge with 5925 P2 particle filter and 501 retainer on a 3M bayonet half facepiece or D8059 A1B1E1K1 cartridge with D7925 P2 particle filter and D701 retainer on a 3M Secure Click™ half face respirator HF-800SD Series).

Infectious Micro-organisms
There are a number of microorganisms that are common in the agricultural sector that can cause respiratory issues. The bugs can grow on wet or old straw and grain, and can be released and stirred up by animals. They include diseases like Q Fever, Hantavirus, Psittacosis (from birds). Workers in abattoirs are at risk of exposure to Brucellosis from the aerosols released during slaughtering.

A common exposure is to Legionella bacteria, present in soils, compost and potting mix. Exposure can occur when handling, mixing and digging these materials. Infection is more likely for smokers, those over 50 or with a weakened immune system. Exposure can occur to home gardeners, nursery workers, horticulturalists and those working with green waste.

Workshop activities
It is common for agriculture to have workshops where some metal work is performed. Risks arising from welding, grinding, painting, fuel filling, etc. should be considered.

RESPIRATORY PROTECTION
Most particle exposures will be controlled by use of a particulate type respirator. P1 particulate type respirators can offer protection even in relatively dusty environments like grain handling and loading. P2 particulate type respirators will give protection from those particles and aerosols carrying microorganisms.

Ammonia levels can commonly be very low (nuisance) but if high enough may require a rated ammonia filter (3M 6054 Bayonet or D8059 Secure Click) on a half face piece.

Many pesticide exposures from spraying can usually be controlled using a GP1(9913, 9913V) or GP2 (9923V) disposable respirator but there are some exceptions (materials with high vapour pressure) requiring a half facepiece with organic vapour & particle filters e.g exposures when mixing concentrates - when in doubt check the safety data sheets (SDS) or seek expert advice.

Fumigants can be at lethal levels in some situations - great care should be taken when selecting respiratory protection.

*https://www.tandfonline.com/doi/full/10.1080/19338244.2019.1593920#d1e407

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