PROJECT SUMMARY

RURAL INDUSTRIES
Research & Development Corporation

Manure amendments can significantly reduce stable fly numbers

The Western Australian Broiler growing industry produces in excess of 225,000m3 of spent broiler litter per annum. By-products of intensive animal production have long been recognized as an important soil amendment, providing nutritive value for crops and pastures as well as soil health attributes through increased carbon storage and the development of robust soil microbial populations. Unfortunately, stringent restrictions on the use of poultry manure were imposed through the Health (Poultry Manure) Regulations 2001 and more recently through the Biosecurity and Agriculture Management Act 2007 (BAM Act).

This is primarily due to the fact that unacceptable levels of stable flies (*Stomoxys* calcitrans) breed in raw poultry manure when used as a fertiliser in irrigated horticulture (principally vegetable production). Due to the continual negative impact of this blood-feeding fly on livestock production and the lifestyle of rural residents along the Swan Coastal Plain, the stable fly was made a declared pest under the BAM Act in 2013. The regulation of manure disposal options have led to loss of important manure market options causing significant cost increases (>$4m) to the WA broiler growers.

Currently the Western Australian compost industry does not have sufficient scale, capacity or end market to process the entire allotment of broiler litter and therefore large quantities of litter are transported to broad-acre agricultural zones for pasture and crop fertilisation. The broiler industry recognises the importance of responsible manure management and therefore proposes to further develop application framework to ensure that the remaining markets are not closed to manure application, causing significant escalation of manure disposal costs and threatening the viability of the local poultry industry.

As part of a RIRDC-funded project (Reducing stable fly emergence in soils amended with litter: PRJ 009946) we looked at various amendments that could be added to poultry litter that would significantly reduce and even prevent the development of stable fly from the litter when used either in irrigated or non-irrigated agriculture. Amendments that were tested included alkalizers (i.e. lime sand, quicklime, sodium carbonate (soda ash) and shell grit), acidifiers (aluminium sulphate, sodium bisulphate), the fertiliser gypsum and the slow release nitrogen fertiliser calcium cyanamide (that has pesticidal properties), and several entomopathogenic fungi (i.e. lethal to insects). Several trials have exposed raw broiler litter in irrigated horticulture with the various amendments added by volume prior to the litter being placed in the field where stable flies were active.

In summary, the three trials clearly highlighted that sodium bisulphate and calcium cyanamide reduced stable fly numbers by as much as 95% and 99% respectively when added to

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raw broiler litter. Alkalizers such as lime sand and shell grit did not have any significant effect on adult stable fly development, even when the former was added at 50:50 ratio. Although quicklime at 10% by volume reduced fly development by over 80%, this material is quite hazardous to handle and addition to spent litter would be problematic at best with no guarantee of preventing stable fly breeding. The first promising amendment was sodium bisulphate, which has been previously used as an additive to calf bedding to reduce stable fly development (Calvo et al. 2010) and is the active ingredient in some granular poultry litter treatments used to control ammonia (Blake 2010). Sodium bisulfate has also been shown to significantly reduce the concentration of *Campylobacter* and *Salmonella* in chicken houses (Line 2002).

The breakdown of uric acid in poultry manure produces ammonia gas, which is harmful to the poultry and workers in the facility. However, the production of ammonia gas can be inhibited if it is converted to NH4+ (ammonium), which can be achieved by making the litter pH more acidic. Aluminium sulfate or Alum is an acid that produces hydrogen ions (H+) when it dissolves, which then attach to ammonia to form ammonium. The ammonium further reacts with sulfate ions to form ammonium sulfate—(NH4)2SO4, which is a water-soluble fertilizer. These

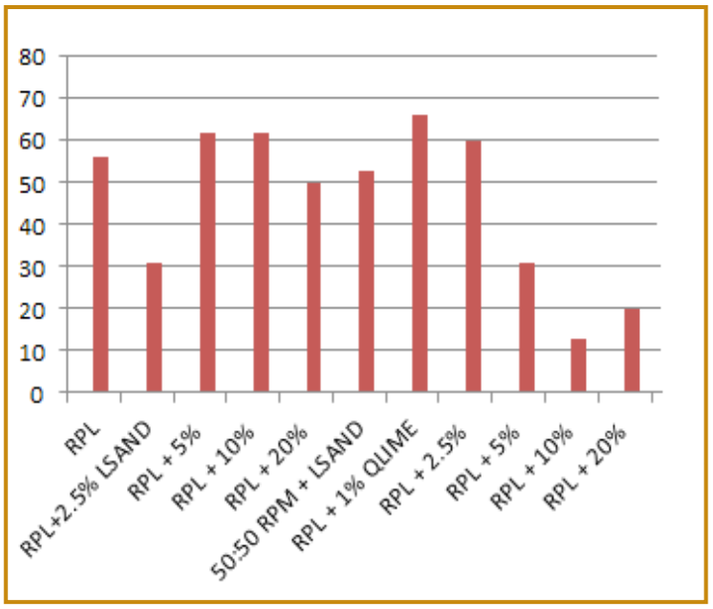

Figure 1. Numbers of stable flies developing from raw poultry broiler litter (RPL) with various alkalizers amendments to reduce stable fly development. Values are mean numbers of flies/1L replicate pad when exposed in irrigated horticulture (February, 2017).

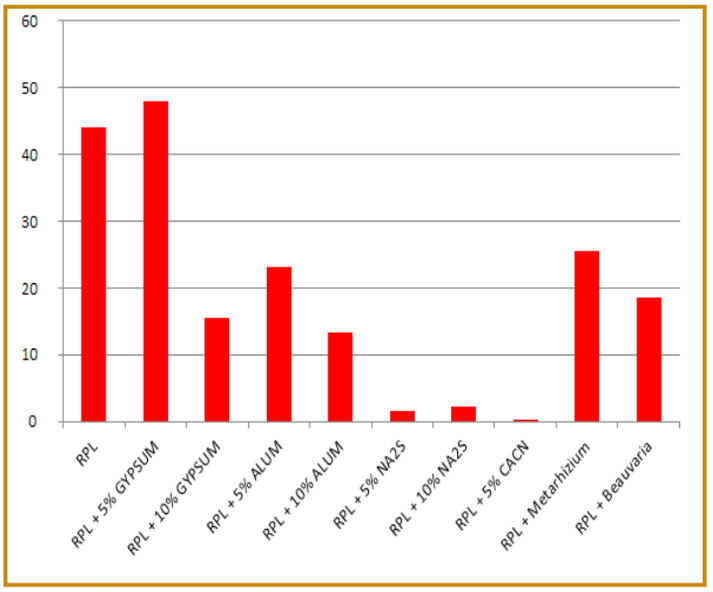

Figure 2. Numbers of stable flies developing from raw poultry broiler litter (RPL) with various amendments to reduce stable fly development. Values are mean numbers of flies/1L replicate pad when exposed in irrigated horticulture (February, 2017).

reactions result in less ammonia gas being emitted from the litter, which also increases the nitrogen content of the litter. Addition of alum to litter also results in the precipitation of phosphorus, therereby reducing phosphorus runoff. Hence, aluminium sulfate can improve poultry production through reducing the negative effects of ammonia production, whilst preventing stable fly development in the spent litter.

The second outstanding amendment was the addition of calcium cyanamide (commercially known as Nitrolime or Perlka®) to the spent litter. Calcium cyanamide is a high grade, slow release nitrogen and calcium fertiliser in agriculture with a significant liming effect and impact on soil borne diseases (Shi et al. 2009). There have been two laboratory studies linking calcium cyanamide with toxic effects on stable fly (Chamberlain & Matter 1986; Chamberlain 1988). When added to spent poultry litter at only 1% by volume there was a 90% reduction in adult stable fly development. This is under optimal conditions for fly development with 1L pads of broiler litter being overhead irrigated several times per day and 5cm thick on the soil surface within a 150mm diameter PVC tube placed into the ground. At rates of 5% addition of calcium cyanamide, there was virtually no stable fly breeding (99-100% reduction). Addition of this product to broiler litter would boost the fertiliser value of the litter (slow release nitrogen) as well as having a bio-fumigant activity against soil borne pathogens.

The next stage of assessment will involve both large scale trials, where complete sheds can have aluminium sulfate or calcium cyanamide broadcast on the spent litter soon after the birds have been removed. The amendment should then be blended in with the litter (using a contravator rotary hoe) and on removal, tested against fly development in irrigated horticulture. The economics of these two options needs to be worked out so that the cost to broiler growers of the amendments can be factored into their production as well as the anticipated cost recovery from selling the nutritionally boosted litter.

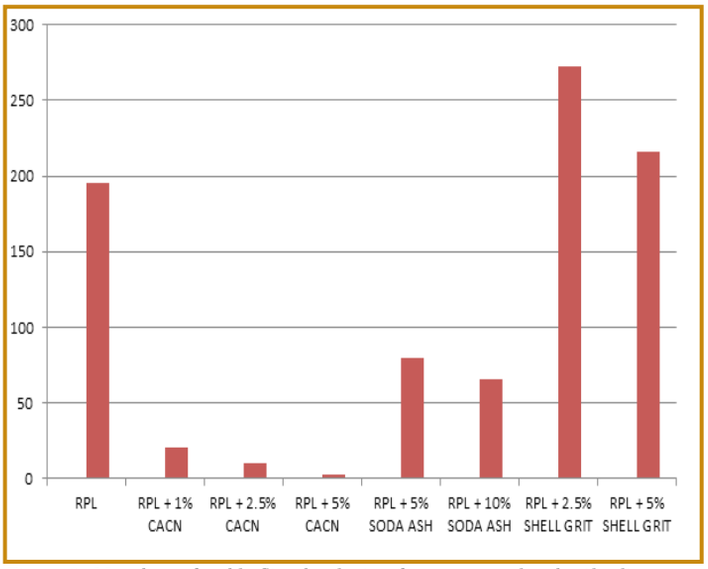

Figure 3. Numbers of stable flies developing from raw poultry broiler litter (RPL) with various amendments to reduce fly development. Values are mean numbers of flies/1L replicate pad when exposed in irrigated horticulture (March, 2017).

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More Information

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