ACCELERATING ORGANIC MATTER DECOMPOSITION

A new approach to minimise stable or biting fly breeding in rotting vegetable crop residues is urgently needed. One of the keys to stable fly management in vegetable crop residues is getting the organic matter broken down as quickly as possible to both a) reduce the potential for stable flies to develop in the material, and b) decrease the time to next planting, which increases productivity. Enhanced biodegradation of vegetable crop residue after harvest will be tested using bioaccelerants applied to vegetable residues (leaves, stalks, roots and heads) after harvest. This will be compared with current best management practices where unharvested residues are mulched, sprayed with insecticide and then incorporated into the soil.

There are 2 key commercial products that show promise in terms of being able to accelerate OM breakdown as well as altering the microbial populations in the rotting crop residues in such a way that they are not favoured by stable flies to either lay eggs or complete larval development.

The two products are Bioprime® and Digester®. Bioprime is a soil conditioner originally developed as a means of controlling root disease (particularly *Pythium* and *Sclerotinia*) that is made by fermenting molasses with baker's yeast. The amount of oxygen in the fermentation determines how much alcohol, acid or carbon dioxide is made from the sugar in the molasses. Bioprime is made by controlling the amount of oxygen to ensure the maximum amount of both alcohols and acids, which then condense to form esters. Also, nutrients are added to make the yeast in the Bioprime grow quickly. At the end of the fermentation process, there is a lot of yeast biomass, containing protein and vitamins. The fermentation process simply slows down in Bioprime as it becomes pickled in its own acids and the process is then arrested by bursting the yeast cells, making a long term stable product.

Digester is a product also based on molasses fermentation that accelerates organic matter breakdown by "activating the primary decomposers of OM". Digester is powered by signal molecule technology and contains a combination of enzymes, signal molecules, bacteriocins (proteinaceous toxins produced by bacteria to inhibit the growth of similar or closely related bacterial strain(s)) and secondary metabolites from the fermentation of beneficial soil bacteria including *Pseudomonas putida*. These organic compounds activate the soil microbes responsible for decomposition. By speeding up the natural decomposition process, Digester improves nutrient recycling and soil structure and reduces the opportunity for disease over wintering. It also improves soil structure by maximizing aeration through activation of the microbes responsible for repairing soil structure and busting open compacted soil and improving drainage. Digester also suppresses disease as it contains defence proteins called bacteriocins; these antimicrobial compounds attack and clean out pathogens such as rhizoctonia and pythium as well as simply removing the substrates that pathogens would traditionally over winter on.

RATES OF APPLICATION:

Digester recommended rate of application is 6L/ha for vegetable crops. Maintenance dose: 4lt/ha sprayed across the total growing area post harvest: Compacted soil/anaerobic conditions/high disease pressure/cold wet spring = 6lt/ha sprayed across the total growing area post harvest; 2lt/ha added to early spring Mycorrcin application.

For best results with Digester, use a minimum water rate of 100L. For best results spray early morning, in overcast conditions or early evening. Do not use filters finer than 200 micron. Calibrate equipment to give the desired application rate. Digester is compatible with commonly used herbicides and nutritional sprays.

Bioprime recommended rate of application is 50L/ha

Success Naturalyte (10g/L spinosad) insecticide has a recommended rate of application for leafy vegetables is 20mL/L (avoid spraying if rain due in 6hrs)

TRIAL DESIGN

A large area of commercial vegetable production immediately post-harvest is to be treated with a high speed mulcher and then either left untreated, have either of two organic matter accelerator products added at the recommended rates as soon as possible after mulching is complete, or have a pesticide applied to the crop residue. Techniques to minimise biting fly breeding such as enhanced bio-degradation or other methods of waste disposal for treating residues will also be assessed. Both Bioprime® and Digester® will be assessed on their ability to decompose vegetable crop waste, which has the potential to minimise or prevent biting fly development. Three different crops will be tested post-harvest (celery, lettuce and broccoli) on large commercial vegetable growing operations north of Perth over 2 years. There will be 3 replicate plots of each treatment in a randomised block design on each property used for the trials. Each replicate plot is to be approximately 20m long x 5m wide. One treatment will also test the effect of complete removal of crop residue on SF breeding. This will provide information on background numbers of stable flies in order to better determine the option of complete removal of crop residues with subsequent composting if enhanced bio-dregradation is not effective enough against stable fly development. Purpose-built fly emergence traps will be placed over each treatment plot in order to catch subsequent emergence of adult stable flies from the soil, which is expected to occur some 3-4 weeks after harvest is complete.

Treatments

Mulched residues left untreated (control)

Mulched residues treated with Bioprime

Mulched residues treated with Digester

Mulched residues treated with a pesticide

SAMPLING

Soil Microbial Biodiversity will be assessed using the ARISA (Automated Ribosomal Intergenic Spacer Analysis) before mulching and at regular intervals post-mulching.

Organic Matter Breakdown – measure the size of vegetable crop residue every week after application of the bio-accelerator products – visual estimates as well as physical recording (fresh and dry weight of plot subsamples).

Adult Biting Fly Emergence – purpose built fly emergence cages are to measure the numbers and species of flies that emerge from the soil after application of each OM accelerator product. Place traps on soil 14 days after crop mulching and application of products (eg bioaccelerators and pesticide).

Disease Incidence in subsequent vegetable crop

Plant Yield of subsequent vegetable crop

Time to Plant subsequent vegetable crop (is it shortened in areas treated with bio-accelerators).

Measurements	**When**
Fresh weight of crop residue	0, 1, 2, 3 and 4 weeks post-mulching
Dry weight of crop residue	2 and 4 weeks post-mulching
Soil microbial diversity (ARISA)	0, 1, 2, 3 and 4 weeks post-mulching
Adult stable fly emergence	**Put traps out 2 weeks post-mulching**

BOX FIELD TRIALS

In addition to the large field trials outlined above, a simple method of exposing vegetable crop residues to a range of treatment options will be employing using large, black tote boxes. Vegetable crop residues (freshly mulched) are to be placed on a bed of sand within large, black tote boxes (56L capacity) and left exposed in the field between the sprinkler lines where they will receive normal overhead irrigation regime as an existing vegetable crop. A minimum of 10 replicate boxes will be used for each treatment and their order randomized within a line of some 50 boxes during any one trial.

1 hectare is equal to 10,000 m^2.

Each large black tote box is 0.125m^2, which is equivalent to 1 / 80,000th of a hectare

Applying Bioprime:				
at 20L/ha	20L x 10,000m^2	20,000mL	2mL/m^2	0.25mL/tub
at 40L/ha				0.5mL/tub
at 80L/ha				1mL/tub
at 160L/ha				2mL/tub
Applying slaked lime				
At 10t/ha	10,000kg/ha = 1 kg/m^2		125g per tub or 0.125m^2	
At 20t/ha			250g per tub	
Applying Digester				
At 3L/ha			0.3mL/m2	0.0375mL/tub
At 6L/ha			0.6mL	0.075mL/tub
At 12L.ha			1.2mL	0.15mL/tub