Closing the loop: Black Soldier Fly (BSF) technology to convert agricultural waste

BSF Project Update #2
June 2021

Overview

The project activities are progressing and all deliverables under Milestone 2 have been met. Initial pot trials and lab experiments have been completed and the preliminary results are providing insights on the performance, characteristics and effects of waste streams on BSF frass and larvae production. Further refinement of manure-based BSF frass and BSF larvae to reduce nutrient toxicity and yield impact is required.

Several literature reviews and data collections have been finalised and a range of outputs are being prepared for publication. The preparatory work required for BSF product development has been completed, and the research survey has been developed.

The team is forming positive working relationships with industry partners and stakeholders by participating in regular meetings.

Communication & Engagement

- An industry focus group has been established for the project.
- Newsletter articles have been published, including:
  - ✓ UWA News, March 2021. Link.
  - ✓ Queensland Country Life, Feb 2021. Link.
  - ✓ National Poultry Newsletter, July 2021. Link.
- Social media platforms are being utilized to inform and engage with the BSF industry, particularly Twitter #BSFwastetoprofit.
- An ARE/AARES research seminar "Closing the loop: Black Soldier Fly technology to convert agricultural waste" was delivered at UWA, 21 May, 2021. Link.

Snapshot of results

- Pot trials have shown that using manure-based BSF frass and BSF larvae to grow wheat, lettuce and chili is causing a yield decline and nutrient toxicity.
- BSF larvae raised on manures have a high nutritional profile making it a potential soil improver.
- Potential pathogenic bacteria types found in BSF larvae fed manure from a single farm were similar to those fed a vegetable mix.
- Treating poultry manure with BSF technology prior to land application appears to lower greenhouse gas into the atmosphere and reduce N leaching.
- There is no evidence of stable fly emergence in soils treated with BSF frass.
- LCFA-processed frass plays a key role in regulating the bacterial community structure in soil.
- Microdialysis investigation shows BSF protein is capable of extended nutrient release relative to urea source, over a time-period that extends beyond 85 days, with possibly lower cumulative nitrate extraction.
- Microdialysis also indicates that formulation of the BSF protein with a nitrification inhibitor (DMPP) strongly decreased nitrate formation, and slightly increased retention of ammonia. DMPP in the protein fertilizer formulation greatly decreased the high nitrous oxide emission potential that occurs where the protein was incubated in soil.

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Research Activities

Screening and optimisation of waste streams

- Trials are continuing on waste streams, including an industry mix of poultry, broiler, pig and abattoir wastes, including new pre-treatments and balancing larvae diet.
- Desktop and nutritional profiles are being established on waste streams from layers, broilers, piggeries, and meat processing.

Image: Chili experiments with BSF products

Economic feasibility, socio-economic costs and benefits, and market evaluation

- A report on the top waste-producing areas for each state including an analysis of the spatial availability of farm animal wastes in Australia.
- A survey was finalised with industry stakeholders and distributed to waste producers across Australia.

Assess the biosecurity risks of BSF products (frass and larvae)

- Stable fly emergence was tested at three field sites in Gingin, using three application rates of frass products.
- Pathogen experiments are being conducted.

Assess the environmental risks of BSF products (frass and larvae)

- Two experiments to assess the leaching risk of frass have been set up and are underway; a batch equilibration experiment and a leaching pot trial with and without plants.
- A microcosm experiment, including 4 different treatments, was incubated for 2 weeks to investigate the impact of different amendments on nitrous oxide, carbon dioxide and methane emissions.

Assess the benefits of using BSF frass and/or larvae as a soil improver

- A laboratory trial has been set-up to investigate the slow-releasing effect of N after embedding the BSF frass in three different fatty acids (lauric, myristic and stearic acid).
- The impact of treatments on bacterial diversity are being assessed.
- A laboratory incubation and pot trial experiment is being set up to investigate the nutrient availability, uptake, and microbial abundance in response to frass.

Image: Disc Granulator

Develop a granulated and/or pelletised fertiliser product

- Binding agents are being improved, and development of a mechanised pelletisation process is ongoing.

Develop a slow release encapsulated fertiliser product (DAF, Queensland)

- The growth accelerator has been modified to accept the new trials, significantly improving the capability of delineating differences between nutrient supply profiles of different formulations.
- The first reaction vessel microdialysis and online gas emissions trial has been conducted with a range of soldier fly protein-based fertilizer formulations.

Public perception

- Target groups of potential end-users of the BSF fertiliser products were identified and a national end-user survey administered to explore growers' interest and likelihood to use BSF fertiliser or soil improver products.

Next Steps

The team will conduct further BSF growth experiments to assess additional waste streams and impact on larvae growth. Further experiments to understand the persistence of pathogenic microorganisms in manure, larvae and frass is ongoing, as well as further research into the risk of runoff, leaching and greenhouse gas and odour emissions following the application of frass and frass-derived products to land. A project website and communication material will be developed.

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