Creating fertilisers from agricultural wastes using Black Soldier Fly - mixing frass with solid fatty acids

Black Soldier Fly farming FACT SHEET

Key Points:

- Black Soldier Fly (BSF) frass is high in mineral nitrogen and organic carbon and can improve plant growth and nitrogen use efficiency.
- Mixing BSF frass with solid fatty acids can be used as a slow-release nitrogen fertiliser

Introduction

Black Soldier Fly (*Hermetia illucens*) is a non-invasive, introduced species that can be used to turn farm waste into useful products. The larvae of Black Soldier Flies (Figure 1) consume organic waste as a food source. The larvae themselves can be harvested to extract protein, oil and fatty acids from their biomass.

From waste to fertiliser

A co-product of Black Soldier Fly farming is an organic material known as 'frass' (see Box 1 and Figure 2). Frass can be high in mineral nitrogen and organic carbon and has been used as a fertiliser and soil amendment[1].

Frass can increase plant growth[1,2] and yields[3], and can improve nitrogen use efficiency by plants[4].

However, there is concern that the high content of mineral nitrogen in frass could result in nitrogen loss to the environment. One potential solution is to mix frass with solid fatty acids that are harvested from the larvae themselves[5].

Laboratory experiment

Researchers conducted a laboratory experiment where they mixed Black Soldier Fly frass with a solid fatty acids extracted from Black Soldier Fly larvae (lauric acid).

The researchers then amended moist soil with the mixture of frass and solid fatty acid and observed the release of mineral nitrogen over 28 days.

Frass was applied to soil at a rate of 46 kilograms of nitrogen per hectare.

Box 1. What is 'frass'?

Frass is a co-product from Black Soldier Fly farming. When Black Soldier Fly larvae consume organic waste, they convert some of the waste into biomass and some is excreted in their castings. As the larvae grow, they shed their exoskeletons (skins).

Frass is composed of the larvae's excrement (castings), their exoskeletons, and the remains of their food source.

Figure 1. Black Soldier Fly larvae

Figure 2. Black Soldier Fly frass

Closing the loop: Black Soldier Fly technology to convert agriculture waste is a research project under the Rural Research and Development for Profit (RnD4P) program funded by the Australian Government and multiple industry partners.

Australian Government
Department of Agriculture, Fisheries and Forestry

Findings

The experiment showed that approximately 50-70% of the mineral nitrogen released from frass into soil over the four weeks was in the form of ammonium (Figure 3). Ammonium is the form of mineral nitrogen preferred by plants.

This result shows that Black Soldier Fly frass contains a high proportion of mineral nitrogen in a form that is preferred by plants.

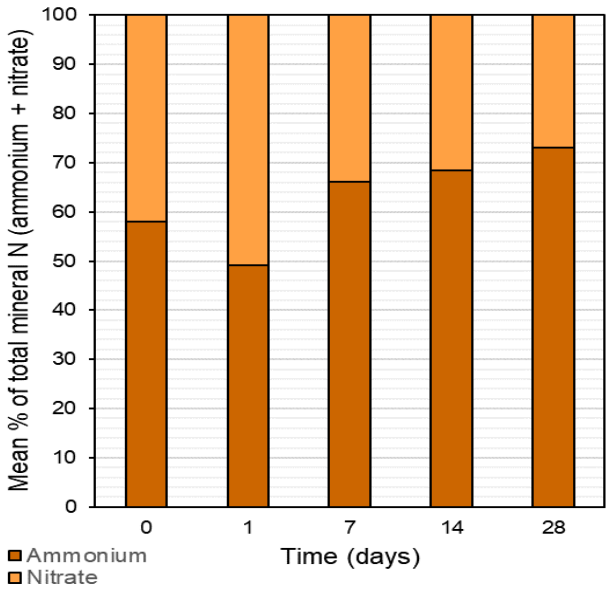

Figure 3: Mean percentage of the mineral nitrogen released from frass into soil that was in the form of either ammonium or nitrate.

The experiment also showed that mixing frass with solid fatty acid decreased the amount of ammonium nitrogen that was released into soil, compared to applying frass on its own (Figure 4). The decrease in release of ammonium from frass occurred after the first week.

This result has a number of implications for the use of frass from Black Soldier Fly farming. First, it means that mixing frass with solid fatty acids has potential to decrease harmful losses of nitrogen to the environment, compared to applying frass on its own. Second, it means that frass mixed with solid fatty acids can potentially be used as a slow-release nitrogen fertiliser. Lastly, it may improve nitrogen use efficiency when frass is applied as a fertiliser.

References

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4. Beesigamukama et al., Frontiers in Plant Science, 2020, 11: 1-17
5. Giroto et al., Scientific Reports, 2017, 7(1): 46032

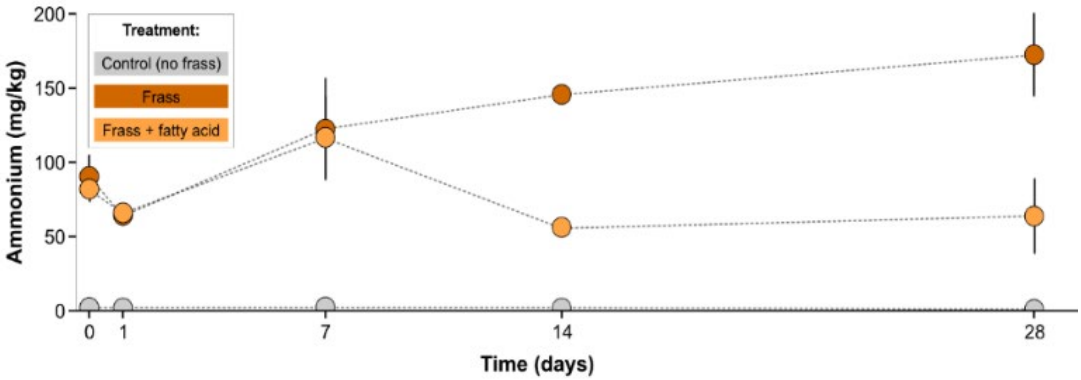

Figure 4: Changes over time in the ammonium nitrogen concentration in soil (milligrams nitrogen / ammonium per kilogram of soil) that was amended with frass on its own (red circles) or frass mixed with fatty acid (orange circles). Nitrogen release was also measured from soil not amended with frass or fatty acid (grey circles).

Further reading

For more information and access to reports and publications, visit the website or contact a research team member.

Contact details

Dr Sasha Jenkins, Project Leader
(08) 6488 8779
sasha.jenkins@uwa.edu.au

Dr Marit Kragt, Deputy Project Leader
(08) 6488 4653
marit.kragt@uwa.edu.au

UWA School of Agriculture and Environment
University of Western Australia (M087)
35 Stirling Hwy, Crawley WA 6009.

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