Zoological and Entomological Letters

E-ISSN: 2788-8428
P-ISSN: 2788-8436
ZEL 2023; 3(2): 04-07
Received: 18-04-2023
Accepted: 11-05-2023

Hager Ashour Salah
Researcher, Industrial Entomology Approaches Project, Egypt

Dina Housam Abd El-Monem
Associated Professor at Entomology Department, Faculty of Science, Cairo University, Egypt

Eman Alaaeldin Abdelfattah
Associated Professor at Entomology Department, Faculty of Science, Cairo University, Egypt

Correspondence Author:
Hager Ashour Salah
Researcher, Industrial Entomology Approaches Project, Egypt

Industrial entomology approaches as an innovative tool of composting

Hager Ashour Salah, Dina Housam Abd El-Monem and Eman Alaaeldin Abdelfattah

DOI: https://doi.org/10.22271/letters.2023.v3.i2a.62

Abstract
Industrial entomology is the study of the application of insects to industrial processes. This field has the potential to revolutionize the way we compost organic waste. Insects can be used to accelerate the composting process, improve the quality of the compost, and reduce the environmental impact of composting. Therefore using the insect approaches can be considered as a tool of climate change mitigation. Industrial entomology approaches offer a number of advantages over traditional composting methods. Insects are more efficient at breaking down organic matter than other methods, and they can produce compost in a shorter period of time. Insects also produce compost that is of higher quality, with a better nutrient balance. In addition, industrial entomology approaches are more environmentally friendly than traditional methods, as they do not require the use of chemicals or water. However the beneficially of using insects in composting, there are a lot of challenges of up calling of this technique in industry. So, more studies can proof the waste reduction efficiency and compost yield of Insect based technology as an innovative industry. This can inform the decision-making for implementation of organic waste treatment facilities.

Keywords: Industrial entomology, composting, black soldier fly, climate chnage mitigation, biotic factors

Introduction
Composting is the process of turning organic waste into compost, which is a nutrient-rich soil additive. Composting is an excellent technique to minimise trash and may be done at home or in a business setting. Enhance soil quality and aid in reducing the consequences of climate change, according to Chen *et al*. (2011) [5]. Depending on the kind of composting system being used, the inputs for composting can change. However, a source of nitrogen and carbon are necessary for the majority of composting systems. Straw, grass clippings, and leaves are examples of carbon-rich materials. Manure, leftover food, and coffee grounds are examples of nitrogen-rich materials (Amlinger *et al*., 2008) [3]. In the biological process known as composting, organic wastes are hygienically transformed into a homogenous and plant-available substance through an exothermic bio-oxidation.
The organic substrate is biodegraded by a varied community of bacteria, archae a, and fungi (De Bertoldi *et al*., 1983) [7]. Organic trash decomposes more quickly than other types of waste. Agriculture garbage, market waste, and kitchen rubbish are only a few examples of the organic waste. If not effectively handled, this rubbish could result in a number of environmental problems, most notably an increase in the greenhouse gases that contribute to climate change (Lou and Nair, 2009) [9]. Therefore, the best inexpensive option to address this issue is composting. Composting is a process that can break down many types of organic waste, including leftover fruits, vegetables, plants, and yard waste. The organic waste component can be used to regulate the environment, as crop fertilisers, and as plant nutrients. The quality of compost products can be impacted by a variety of factors due to the fact that different types of organic waste contain varying amounts of nutrients including nitrogen, phosphorous, and potassium (N, P, and K), which are the typical macronutrients found in fertilisers. Temperature, pH, moisture content, and the carbon nitrogen ratio (C: N) are the main variables that govern how successfully compost is created, while there are many other elements that can alter the compositing process and/or products (Nozhevnikova *et al*., 2019) [13]. As a result, composting is seen as an environmentally friendly method of managing organic waste because it can reduce waste, enhance soil quality, cut down on water use, control weeds, draw in beneficial insects, and even slow down the effects of global warming.

The purpose of this article is screening the advantages of industrial Entomology approaches as a tool of composting and give a summary of the various types of insect species that are available. The evaluation will also go over composting's ability to mitigate climate change's effects.

Organic waste problems

Organic waste is a major environmental problem. It is estimated that about 40-60% of all municipal solid waste is organic according to the country. This waste can end up in landfills, where it decomposes anaerobically and produces methane, a potent greenhouse gas. Methane is 25 times more effective at trapping heat than carbon dioxide, so it is a major contributor to climate change. In addition to methane emissions, organic waste in landfills can also leach into groundwater, contaminating drinking water supplies. Organic waste can also attract pests and rodents, which can spread disease.

There are a number of ways to reduce the environmental impact of organic waste. One way is to compost it. Composting is the process of breaking down organic matter into a nutrient-rich soil amendment. Composting can help to reduce methane emissions, improve soil quality, and save water. Another way to reduce the environmental impact of organic waste is to anaerobically digest it. Anaerobic digestion is the process of breaking down organic matter in the absence of oxygen. This process produces biogas, a mixture of methane and carbon dioxide. Biogas can be used to generate electricity or heat, or it can be used to fuel vehicles. The management of organic waste is an important issue that needs to be addressed. By reducing the amount of organic waste that ends up in landfills, we can help to mitigate climate change and protect our environment (Nakasaki *et al*., 2009) [12].

History of industrial Entomology approaches:

The history of industrial entomology and its application to composting is a long and complex one. Insects have been used for centuries to control pests and improve soil fertility. In the early 20th century, scientists began to explore the potential of insects to be used in industrial processes. (da Silva, and Hesselberg, 2020) [6]. One of the earliest examples of industrial entomology was the use of entomopathogenic nematodes (insect-killing nematodes) to control insect pests. Entomopathogenes nematodes are microscopic worms that can be used to control a wide variety of insect pests. They are especially effective against pests that are difficult to control with other methods (Vashisth *et al*., 2013) [15]. The other promising industrial entomology approach was the use of worms to break down organic matter and produce compost. Worm composting, is a process that uses worms to decompose organic waste (Abdelfattah, and Renault, 2023) [1]. In the 1970s, there was a growing interest in the use of insects for industrial purposes. This led to the development of a number of new industrial entomology approaches to composting. One of the most promising new approaches is the use of black soldier flies (Hermetia illucens) to produce compost. Black soldier flies are a type of fly that can be raised in large numbers. They are very efficient at breaking down organic matter, and they can produce compost in a relatively short period of time (Mahmoud *et al*., 2022) [10]. The use of industrial entomology approaches to composting has a number of advantages over traditional composting methods. Insects are more efficient at breaking down organic matter than other methods, and they can produce compost in a shorter period of time. Insects also produce compost that is of higher quality, with a better nutrient balance. In addition, industrial entomology approaches are more environmentally friendly than traditional methods, as they do not require the use of chemicals or water (Badawi *et al*., 2023) [4]. Fig. (1) Showed the overview of Industrial Entomology History. Early history: The use of insects for industrial purposes can be traced back to ancient times. For example, the Chinese have been using silkworms for centuries to produce silk. In the middle Ages, European farmers used earthworms to improve soil fertility. In the 19th century, there was a growing interest in the use of insects to control pests. This led to the development of a number of new insecticidal products, including pyrethrins and rotenone. In the 20th century, there was a growing interest in the use of insects for industrial purposes. This led to the development of a number of new industrial entomology approaches, including the use of entomopathogenic nematodes, worms, and black soldier flies to produce compost. While, in the 21st century, there is a growing interest in the use of industrial entomology approaches to composting. This is due to a number of factors, including the increasing demand for compost, the environmental benefits of industrial entomology approaches, and the development of new technologies that make it easier to use insects for industrial purposes. The future of industrial entomology in the field of composting is so interesting. As the demand for compost continues to grow, industrial entomology approaches will become increasingly important. Industrial entomology approaches offer a sustainable and efficient way to produce compost, and they have the potential to revolutionize the way we manage organic waste.

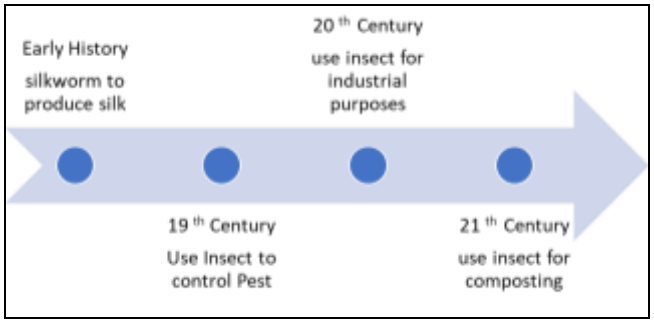

Fig 1: Overview of Industrial Entomology History.

From insect to compost

As the world's population grows, the demand for compost is increasing. Industrial entomology approaches offer a promising solution to the challenge of composting organic waste in a sustainable way. Insects have been used for centuries to decompose organic matter and improve soil fertility. In recent years, there has been a growing interest in the use of insects for composting. This is due to a number of factors, including the increasing demand for compost, the environmental benefits of using insects, and the development of new technologies that make it easier to use insects for industrial purposes. here are many of insect species can be used as a tool of composting. (Miranda *et al*., 2021) [11]. There are a number of different types of insects that can be used for composting. Some of the most common include: Black soldier flies (*Hermetia illucens*): Black

soldier flies are a type of fly that can be raised in large numbers. They are very efficient at breaking down organic matter, and they can produce compost in a relatively short period of time (Fig. 2).

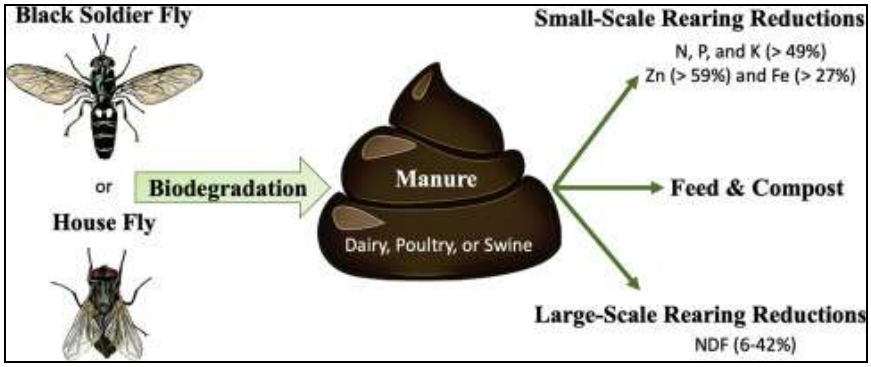

Fig 2: Flies species as a tool of composting (Miranda *et al*., 2021) [11]

Also, Phorid flies (*Megaselia spp.*) can help to improve the quality of the compost by adding beneficial bacteria and fungi. However, they are not as efficient at breaking down organic matter as black soldier flies (Shikano *et al*., 2021) [14]. Addationally, Worms are a type of invertebrate that can be used to break down organic matter and produce compost. Worm composting, also known as vermicomposting, is a relatively simple process that can be done in a variety of settings (Domínguez-Negrete *et al*., 2021) [8]. The benefits of using insects for composting include the following points, reduced environmental impact: Insects are a more sustainable way to produce compost than traditional methods, as they do not require the use of chemicals or water. Additionally, increased nutrient content: Insects can help to increase the nutrient content of compost, making it more beneficial for plants; and finally, improved soil quality: Compost produced by insects can help to improve soil quality, making it more fertile and productive. The use of insects for composting is a promising new technology that has the potential to revolutionize the way we manage organic waste. As the demand for compost continues to grow, insects will become an increasingly important part of the composting process (Badawi *et al*., 2023) [4].

The future of Industrial Entomology as a tool of composting

The future of industrial entomology approaches as a tool of composting is so interstic regarding the social, environmental, and economic aspects. As the demand for compost continues to grow, industrial entomology approaches will become increasingly important. Industrial entomology approaches offer a sustainable and efficient way to produce compost, and they have the potential to revolutionize the way we manage organic waste.

There are a number of factors that are driving the growth of industrial entomology approaches to composting. These factors include:

- The increasing demand for compost: The demand for compost is growing due to the increasing popularity of organic gardening and the need to reduce the environmental impact of waste disposal.
- The development of new technologies: The development of new technologies, such as insect rearing systems and composting equipment, is making it easier to use insects for composting.
- The increasing awareness of the benefits of composting: The public is becoming more aware of the benefits of composting, such as the reduction of methane emissions and the improvement of soil quality.

Otherwise, there are a number of challenges that need to be addressed in order to realize the full potential of industrial entomology approaches to composting. These challenges include:

- The need for more research: More research is needed to optimize the use of insects for composting and to ensure that the process is safe and environmentally friendly.
- The need for government support: Government support is needed to help develop and promote industrial entomology approaches to composting.
- The need for public education: Public education is needed to raise awareness of the benefits of composting and to encourage people to use industrial entomology approaches.

Conclusion

Composting is a natural process that can be used to convert organic materials into a nutrient-rich soil amendment called compost. The using of industrial Entomology approach is considered as a talent tool for composting. Black soldier fly is considerd as the promising insect tool for compost production to mitigate the deleterious effect of improper management of organic waste on climate change. The following points can summarize the specific benefits of using industrial entomology approaches to composting:

- Reduced environmental impact: Insects are a more sustainable way to produce compost than traditional methods, as they do not require the use of chemicals or water.
- Increased nutrient content: Insects can help to increase the nutrient content of compost, making it more beneficial for plants.
- Improved soil quality: Compost produced by insects can help to improve soil quality, making it more fertile and productive.
- Reduced methane emissions: Insects break down organic matter in a way that produces less methane than traditional composting methods.
- Disease control: Insects can help to control pests and diseases, which can benefit both the environment and human health.

Acknowledgement

This Study was developed by “Enhancement of Industrial Entomology approaches to mitigate the climate change effect project whisc was funded by Academy of Scientific Research and Technology (ASRT).

References

1. Abdelfattah EA, Abdel Azeem EA. The integration between insect biomonitoring study and GIS study to assess the pollution impacts as oxidative stress parameters within Abu-Zaabal industrial area. Journal of Wildlife. 2023;1(1):1-10.
2. Abdelfattah EA, Renault D. Does the presence of heavy metal and catechol contaminants in organic waste challenge the physiological performance of the bioconverter Hermetia illucens?. Journal of Insect Physiology. 2023;144:104469.
3. Amlinger F, Peyr S, Cuhls C. Greenhouse gas emissions from composting and mechanical biological treatment. Waste Management and Research. 2008;26(1):47-60.
4. Badawi EY, Elkharsa RA, Abdelfattah EA. Value proposition of bio-hydrogen production from different biomass sources. Energy Nexus; c2023. p.100194.
5. Chen L, de Haro Marti M, Moore A, Falen C. The composting process. In Dairy manure compost production and use in Idaho. Idaho: University of Idaho. 2011;2:513-532.
6. da Silva GDP, Hesselberg T. A review of the use of black soldier fly larvae, *Hermetia illucens* (Diptera: Stratiomyidae), to compost organic waste in tropical regions. Neotropical entomology. 2020;49(2):151-162.
7. De Bertoldi MD, Vallini G, Pera A. The biology of composting: A review. Waste Management and Research. 1983;1(2):157-176.
8. Domínguez-Negrete A, Gómez-Rosales S, Angeles M. DL, López-Hernández LH, Reis de Souza TC, Latorre-Cárdenas JD, Téllez-Isaias G. Addition of different levels of humic substances extracted from worm compost in broiler feeds. Animals. 2021;11(11):3199.
9. Lou XF, Nair J. The impact of landfilling and composting on greenhouse gas emissions-a review. Bioresource Technology. 2009;100(16):3792-3798.
10. Mahmoud AH, Hussein MY, Ibrahim HM, Hanafy MH, Salah SM, El-Bassiony GM, Abdelfattah EA. Mixed microalgae-food waste cake for feeding of *Hermetia illucens* larvae in characterizing the produced biodiesel. Biomass and Bioenergy. 2022;165:106586.
11. Miranda CD, Crippen TL, Cammack JA, Tomberlin J. K. Black soldier fly, *Hermetia illucens* (L.) (Diptera: Stratiomyidae), and house fly, Musca domestica L.(Diptera: Muscidae), larvae reduce livestock manure and possibly associated nutrients: an assessment at two scales. Environmental Pollution. 2021;282:116976.
12. Nakasaki K, Idemoto Y, Abe M, Rollon AP. Comparison of organic matter degradation and microbial community during the rmophilic composting of two different types of anaerobic sludge. Bioresource Technology. 2009;100(2):676-682.
13. Nozhevnikova AN, Mironov VV, Botchkova EA, Litti YV, Russkova YI. Composition of a microbial community at different stages of composting and the prospects for compost production from municipal organic waste. Applied Biochemistry and Microbiology. 2019;55:199-208.
14. Shikano I, Woolcott J, Cloonan K, Andreadis S, Jenkins NE. Biology of Mushroom Phorid Flies, Megaselia halterata (Diptera: Phoridae): Effects of Temperature, Humidity, Crowding, and Compost Stage. Environmental entomology. 2021;50(1):149-153.
15. Vashisth S, Chandel YS, Sharma PK. Entomopathogenic nematodes-A review. Agricultural Reviews. 2013;34(3):163-175.