BOOK OF ABSTRACTS

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Keynotes

The Metabolic Landscape of BSFL Substrate: Pathways, Pitfalls, and Possibilities

Martin J. Zorrilla

RePloid Deutschland GmbH

Black soldier fly larvae (BSFL) bioconversion occurs within metabolically active substrates where larval and microbial processes create complex feedback loops that determine system outcomes. Larval feeding behavior enhances substrate aeration, driving high-energy aerobic microbial respiration and heat production, which in turn influences larval development and bioconversion efficiency. Under oxygen-limited conditions, diverse anaerobic metabolic pathways predominate, including fermentation processes that fundamentally alter substrate chemistry with implications for larval health, emissions, and product quality. These oxygen-mediated metabolic shifts create thermal trajectories with critical tipping points—aerobic conditions can trigger positive feedback loops leading to rapid temperature increases and enhanced microbial activity, while anaerobic pathways may offer distinct advantages such as nutrient preservation alongside potential challenges including system stagnation. Despite this complexity, the system can be strategically controlled through management of physical substrate properties such as bulk density and porosity, offering opportunities to optimize operational costs while improving rearing outcomes and product sustainability.

Olympia Yarger

GoTerra

Olympia, the founder and CEO of Goterra. With a relentless commitment to innovation and sustainability. Olympia designed and commercialised the world's first decentralised, autonomous, insect farms. This technology is now deployed across Australia processing resources onsite, where waste is created. She designed the Australian Federal Governments Insect Protein regulatory framework and was a pivotal member of the working group that approved insect protein for livestock feed in Australia. Olympia's technology is reshaping not just the agricultural landscape but also how we imagine the future of food waste management. Her work has been recognised globally in Agricultural and insect protein industries and the CSIRO has identified a recently discovered species of Soldier Fly in her name.

David Zilberman

UC Berkeley

David Zilberman is a Distinguished Professor of Agricultural and Resource Economics at UC Berkeley. He received the 2019 Wolf Prize in Agriculture and was elected a member of the U.S. National Academy of Science in 2019. A description of David's work and career appears here.

David served as the 2018-19 President of the Agricultural & Applied Economics Association (AAEA). He's a fellow of multiple professional associations and has published in professional and popular outlets. He has over 400 referenced journal articles ranging from Science to ARE-Update and has edited 30 books. In addition, he has served as a Consultant to the U.S. Environmental Protection Agency, USDA, the World Bank, FAO, MARS, BP, WWF, Shell and others. David got a BA from Tel Aviv University and a Berkeley Ph.D. David co-founded the Beahrs Environmental Leadership Program,the International Consortium of Applied Bioeconomy Research and is the founder and academic director of the Berkeley MDP program.

David's research analyzes water, innovation, supply chain, agriculture, energy, and the environment. He has researched the economics and political economy of COVID-19 and of agricultural biotechnology, and the potential of the bioeconomy. During the last two years he has study the economics and supply chain design of Black Soldier Fly waste management systems.

Insights into the black soldier fly gut: an integrated platform for sustainable biotransformation of waste

Gianluca Tettamanti

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Recent studies on the black soldier fly (BSF) reaffirm the interest in this species as a powerful tool for the bioconversion of a wide range of organic waste streams, including challenging substrates rich in complex macromolecules. Beyond its well-established use for producing protein meal, there is a notable shift toward exploring a broader spectrum of applications for BSF-derived biomolecules -including proteins, lipids, chitin, and antimicrobial peptides- for novel industrial and biotechnological applications. The remarkable feeding versatility of BSF larvae is also attracting attention in fields beyond animal nutrition, particularly in bioremediation, where their potential to metabolize or sequester environmental contaminants presents promising ecological benefits.

Despite a growing consensus on the need for a deeper understanding of BSF biology to expand the range of applications in which this insect may offer new sustainable solutions, research on its digestive system remains scarce. This is particularly critical given that the gut constitutes the primary interface for substrate processing and pathogen defense. Furthermore, the gut harbors a highly adaptable and functionally diverse microbiota, representing a reservoir of novel microbes and enzymes with potential applications in various biotechnological fields.

This presentation will explore the current state of knowledge on the BSF digestive system and its associated microbial community, and will discuss their implications for improving larval production, exploiting challenging substrates, and mitigating pollutants in contaminated biomasses.

Talks

Hidden figures: uncovering the invisible contributions of microbes to BSF larval nutrition using a germ-free model [038]

N.A. Sibinga*, and J. De Smet

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Establishing the nutritional requirements of BSF larvae is a critical step towards optimizing nutrition and thereby improving performance on marginal substrates. However, defining these requirements is complicated by the significant (and variable) impact of microbes on substrate composition: microbes compete with BSFL for nutrients in some substrates, but they can also have dramatically positive impacts through conversion or biosynthesis of (micro)nutrients deficient in the basal substrate.

To explore these beneficial impacts, we employed a germ-free (axenic) BSF model using wheat bran (WB) as the basal substrate. In the absence of microbes, BSFL growth on WB is severely inhibited when compared to the control non-sterile condition. By supplementing sterile WB with micronutrients (B vitamins, amino acids, etc.) as well as live and dead microbes, we shed light on the essential nutritional contributions of the microbiome/holobiome.

Improved understanding of the specific contributions of co-cultured microbes to improving substrate quality for BSFL will help to facilitate creation of robust, evidence-based strategies for probiotic selection and microbiome engineering to improve performance on suboptimal substrates. Furthermore, elucidating the “true” nutrient requirements of BSFL by (temporarily) ignoring the contributions of microbes can improve identification of promising novel substrates and lead to precise formulation of mixed substrates.

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Microbes at Work: Boosting Black Soldier Fly Waste Bioconversion with Probiotics [001]

A. Paten*, H. Koch, O. Young, S. Escobar-Correas, and M. Morgan

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Black soldier fly larvae (BSFL) are highly efficiently at bioconverting most organic wastes into valuable products such as insect protein, lipids, and frass. The BSFL gut microbiome plays a central role in this process by mediating the breakdown of complex substrates, influencing metabolic efficiency, and shaping macronutrient utilisation. Leveraging these microbial functions presents an opportunity to further optimise BSFL waste bioconversion.

This presentation highlights recent investigations into how different waste stream diets influence BSFL gut microbiome structure and function, and how targeted inoculation with beneficial microbial strains (probiotics) can be used to:

1. Enhance larval growth and waste conversion efficiency,

2. Improve bioprocessing of recalcitrant substrates (e.g., high-cellulose diets), and

3. Modulate nutrient profiles of larvae and frass for specific downstream applications.

These findings underscore the potential of microbiome-based interventions to improve BSFL bioprocessing outcomes. Ongoing work focuses on developing effective and safe probiotics with scalable delivery methods in collaboration with industry partners.

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Unlocking the Bioactive Power of Black Soldier Fly Larvae for Sustainable Aquafeeds [030]

L. Donati*, M. Bezagu, V. Pierre, J. Henry, and A. Schuller

Innovafeed

As aquaculture scales up to meet global protein demands, traditional feed ingredients like fishmeal face scrutiny for their high cost and ecological impact. Insect-based proteins, particularly from black soldier fly (*Hermetia illucens*) larvae, offer a promising, sustainable alternative. This study investigates the bioactive potential of the water-soluble fraction (WSF) of BSF meal, focusing on its health-promoting properties for aquatic species.

Using transcriptomic analysis, we identified 355,085 transcripts, with 26 neuropeptide precursors and 72 antibacterial peptide precursors, including defensins, cecropins, attacins, and diptericins. Functional assays on rainbow trout intestines revealed a dose-dependent myotropic activity, suggesting enhanced gut motility and potentially improved nutrient absorption. In parallel, antibacterial tests demonstrated growth-inhibitory, bacteriostatic, and bactericidal effects on several key aquatic pathogens, notably *Vibrio penaeicida* and *Lactococcus garvieae*.

These findings confirm that BSF WSF possesses both myotropic and antimicrobial properties, positioning it as a dual-action feed additive. Beyond its nutritional value, it could reduce antibiotic use in aquaculture—an urgent need amid rising antimicrobial resistance. This study supports the integration of insect protein extracts into next-generation, functional aquafeeds for healthier and more sustainable fish farming.

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INSECT-IMP - advancing farmed insect breeding through interdisciplinary collaboration [061] - Sponsor Talk

*L. Skrubbeltrang Hansen**

INSECT-IMP COST Action Network & Center for Quantitative Genetics and Genomics, Aarhus University

With the rapid expansion of insect farming, structured genetic improvement programs are urgently needed to ensure sustainable and efficient insect production. Despite the success of genetic research in traditional livestock, insect species such as the black soldier fly (Hermetia illucens) have received limited attention in this regard. The COST Action network INSECT-IMP addresses this gap by fostering a collaborative network of researchers in genetics, entomology, and veterinary science, alongside stakeholders from across the farmed insect sector. The initiative promotes cross-species knowledge transfer and adapts proven breeding strategies from other animal sectors to insect farming. INSECT-IMP is building a European research capacity, supports evidence-based regulation, and drives innovation in insect breeding through interdisciplinary cooperation. This presentation outlines the objectives, structure, and outcomes of the INSECT-IMP Action, highlighting its potential to transform the genetics of farmed insects and contribute to a more resilient and sustainable bioeconomy.

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Love and war: post-mating interactions between the sexes [016]

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Far from being a simple transfer of sperm from males to females, copulation is a complex process shaped by coevolution between the sexes. During this coevolution, both males and females have been subject to selection for traits that maximise their own reproductive success—sometimes at the expense of the other. The black soldier fly reproduction is a perfect case to highlight these adaptations. The male transfers masses of sperm which block the access to the storage area after mating. He also transfers a large volume of seminal fluid that appears to coagulate in the female spermathecae. As for the female, she is not passive in the sperm storage process. While she stores only a portion of the sperm transferred by the male, remaining sperm are digested in a tubular-shaped organ whose apical epithelial layer is covered by microvilli. This compartment displays proteolytic activity consistent with the gradual digestion of spermatozoa during which the female gets rid of sperm components. Sperm has been suggested to be a nuptial gift in this species; however, our results do not confirm this hypothesis. These results highlight how the post-mating interactions between males and females and their reproductive strategies can lead to sexual conflicts.

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Increasing egg yield in high density *Hermetia illucens* fly cages [007]

C. L. Coudron*, D. Deruytter, and L. De Praetere

Inagro

Egg production is a key parameter for optimizing *Hermetia illucens* production. High, consistent output reduces the number of reproductive cages needed and increases the proportion of larvae available for biomass. Ideally, each female reaches her biological maximum for fertilized egg deposition at designated sites.

Fly density is a major factor, as shown in three trials under controlled conditions (30 °C, 80% RH) in 60 × 60 × 90 cm cages. Densities ranged from 0.5 to 39 flies/litre and were tested with pupae of 73, 111, and 187 mg. Egg yield per cage peaked with the largest flies at the highest density (51.8 g), though individual output declined (~0.12 mg less per extra fly/litre). This trend, though less steep, also appeared with smaller flies.

Ongoing work explores three hypotheses for this decline: (1) limited flight space, tested using 0.3 vs. 1.2 m³ cages; (2) insufficient resting surfaces—vertical area appears ineffective, while horizontal space is under study; and (3) disturbance at the oviposition site, where vertical traps perform better at high density. Enclosed traps and multiple ovitraps are also being tested to reduce crowding and competition.

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Ironing Out the Details: Molecular Responses and Mineral Bioaccessibility of Iron Fortification in Black Soldier Fly Larvae [053]

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Wageningen university and research

Black soldier fly (*Hermetia illucens*) larvae are a promising sustainable protein source with high micronutrient content, including iron. This study examined the effects of dietary iron fortification on larval performance, nutrient composition, and molecular responses. Larvae were reared on diets containing 330 to 6,600 mg/kg of iron, delivered as ferric ammonium citrate. No significant differences were observed in weight, survival, protein and fat content across treatments. However, larvae exposed to 6,600 mg/kg iron occasionally exhibited dark exoskeletal lesions, suggesting potential sublethal stress. Mineral analysis revealed a dose-dependent, threefold increase in tissue iron levels, along with elevated calcium and reduced zinc content. Transcriptomic analysis showed adaptive responses to iron levels up to 1,200 mg/kg by day seven, while diets above 7,000 mg/kg triggered broad and persistent gene expression changes. The dataset provided novel insights into both transcriptional and post-transcriptional regulation of iron metabolism in BSF larvae, including expression changes in ferritin subunits and associated regulatory factors. Prussian blue staining revealed increased iron accumulation in midgut regions previously associated with entoferritin storage. This spatial pattern aligned with gene expression shifts in iron-handling pathways, suggesting elevated local entoferritin content. These findings support iron fortification to enhance insect nutritional value while identifying thresholds to avoid physiological stress.

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Protein content assessment in black soldier fly larvae via thermal and near-infrared multispectral cameras [002]

A. Qaddura, T. Avikasis Cohen, M. Elbaz, and A.Brook*

University of Haifa

The rearing stage of black soldier fly larvae (BSFL) is considered a black box and is not constantly and undisturbedly monitored. BSFL phenotypes are highly diversified as a result of the complex interaction between its physiology, biochemistry, and environmental conditions. It is thus not surprising that very little is known about the dynamic between BSFL and the concentrations of the associated proteins. Producers are looking for fast, reliable, and efficient analytical methods to assure quality control of the BSFL. In this study, we thus developed and trained a spectral model using a machine learning algorithm, predictions of protein content from phenotypic spectral features of the BSFL, and diets using NIR multispectral and thermal cameras. The developed algorithm includes the following steps: 1) radiometric calibration, 2) spectral model for protein content in the diet, 3) spectral model for protein content in BSFL, 4) dynamic processes between the diet and the BSFL. The accuracy of the model was validated in an external validation trial, which improved the prediction correlation coefficient performance (from R2 = 0.921 to R2 = 0.935). The findings of this study can inform future research exploring the potential of BSFL to become an important source of highly nutritive protein.

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Exploring the impact of dietary changes during early black soldier fly rearing on their microbiome composition and performance: they are what they eat? [022]

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KU Leuven

Black soldier flies have emerged as one of the most promising insect species for mass rearing and bioconversion in a circular economy, thanks to their ability to efficiently convert a remarkably diverse array of organic substrates into high quality biomass. To ensure circularity, the key challenge for the sector is aligning this flexibility with a standardized output, without resorting to standardized feeds, that compete with other livestock. In this context, this research aimed to understand how this flexibility is best served in practice. Is it best to nurse larvae on a standardized diet before fattening them on an organic side stream? Or to allow diet-adaptation from hatching to that stream? To explore this, the impact of a diet change between the nursing stage (0-7 DAH) and the 'fattening' phase (8-15 DAH) using two diets (chicken feed (CF) and supermarket waste (SW)) was investigated for both the microbiome and the larval performance. Such a diet shift reduced larval growth during the first 72 hours, though effects seem to fade towards the end of fattening. At the same time, the bacterial community analysis showed distinct communities between CF- and SW-reared larvae, that were only interchangeable to a certain extent. These initial results indicate towards a need for co-optimization of both stages.

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Feeding the Networks: Diet-Driven Microbial Interactions in BSFL Guts [058]

R. Saho, A. MacInnis, J. Tomberlin, & Z. Burcham*

University of Tennessee, Knoxville

Black soldier fly larvae (BSFL) are emerging as sustainable agents for bioconversion of organic waste into high-value products. However, the role of the gut microbiome in mediating BSFL performance remains poorly defined, particularly with respect to microbial interactions. We conducted a comprehensive meta-analysis of publicly available 16S rRNA gene sequencing datasets to characterize how diet shapes microbial community assembly and ecological network structure in the BSFL gut. Our dataset includes approximately 850 samples from 19 studies, encompassing 9 broad diet classifications ranging from plants to plastics. To characterize the impact of diet on the microbiome, we conducted community diversity analyses to assess community structure, identified core taxa across diets, performed differential abundance testing to detect diet-enriched taxa, and applied co-occurrence network analysis to investigate diet-specific interaction patterns among microbial consortia. Results indicate that while some core taxa are conserved, diet strongly influences network complexity, modular structure, and presence of potential keystone taxa. These findings suggest that the BSFL gut microbiome is not only diet-responsive but also functionally organized into diverse ecological guilds likely governed by microbial interactions. These insights into microbial guilds provide a foundation for optimizing microbiome function in substrate-specific bioconversion, advancing sustainable and efficient BSFL-based waste valorization systems.

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Engineering black soldier flies into titans of industry [026]

K. Tepper*, C. Retief, M. Clark, J. King, K. Petroll, P. Manuneedhi Cholan, C. Pfitzner, S. Kumar, A. Sunna, M. Morsch, S.C. Apte, and M. Maselko

Macquarie University

Black soldier flies (BSF; *Hermetia illucens*) are currently used on industrial scales to process organic wastes into fertiliser and insect protein and oil for animal feed. The scope of possibilities for BSF could be vastly expanded using synthetic biology. BSF could be engineered to efficiently process more types of organic waste and sustainably biomanufacture a variety of high-value biomolecules, including enhanced animal feeds, industrial enzymes, various lipids, secondary metabolites, and enhanced fertiliser. We use the insect genetic model, *Drosophila melanogaster*, to prototype the potential for BSF to be engineered to improve waste management, bioremediation, and biomanufacturing. I will present results demonstrating the expression of industrial enzymes, such as laccase and phytase, as well as bioremediative enzymes for mercury detoxification in *D. melanogaster* and our progress translating these results into BSF. Maturing this research could help BSF become a preferred platform for sustainable and scalable biomanufacturing, an industry that is forecasted to reduce greenhouse gas emissions by 5 % and generate $1 trillion in economic value by 2040.

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Establishing BSF as a Synthetic Biology Platform [031]

M. Maselko*

Macquarie University and EntoZyme

Black soldier flies (BSF, *Hermetia illucens*) offer exceptional promise as a synthetic-biology chassis for sustainable waste management and biomanufacturing. Compared with microbial platforms such as yeast or bacteria, BSF demand far lower capital expenditure, use little water, and thrive on diverse, minimally processed, and non-sterile waste streams. Engineering BSF with transgenes could further widen their diet, boost feed-conversion ratios, and enable production of far higher-value products.

Several groups have already successfully created transgenic and knockout BSF strains. A critical first step. To unlock BSF's full potential we now need a shared, well-characterised toolkit: methods for efficient site-directed integration of large multigene constructs, promoters that drive tissue- or stage-specific expression, inducible or repressible systems responsive to small molecules, validated safe-harbour loci, and robust biocontainment strategies.

In this talk I will outline the case for BSF as a synthetic-biology platform, review the required molecular tools with examples drawn from other organisms, and present recent progress from my laboratory toward a comprehensive BSF molecular toolkit.

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Technical Update on Today's Possibilities in Black Soldier Fly Farming [004]- Sponsor Talk

Bob Holtermans*

Insect Engineers

The Black Soldier Fly (BSF) industry is advancing faster than ever, transforming how we think about sustainable protein, waste management, and circular economy solutions. Today, what was once experimental is now scalable, efficient, and economically viable—yet many producers are still unaware of the full potential of current technology.

In this presentation, Insect Engineers will provide a technical update on the latest possibilities in BSF farming. We will showcase innovations in larval rearing, substrate formulation, automated processing, and climate-controlled systems, highlighting how modern tools like ZOEM racks and state-of-the-art breeding setups are redefining efficiency and consistency in commercial operations.

We will also address the practical side of scaling BSF production: capital and operational costs, ROI optimization, and strategies to maintain quality while increasing throughput. By integrating sustainability with profitability, today's BSF solutions demonstrate that ecological responsibility and business success are not mutually exclusive—they can go hand in hand.

Drawing from hands-on experience and on-site data, this session will give attendees actionable insights to optimize current operations or plan for new facilities. From understanding the biological fundamentals to applying the latest technical solutions, participants will leave with a clear picture of what is achievable today—and what the near future may hold.

Whether you are new to BSF farming or looking to elevate an existing operation, this presentation will equip you with the knowledge to harness current technology, improve efficiency, and explore innovative opportunities in a rapidly growing industry.

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Genetic Selection Drives Scalable Gains in Black Soldier Fly Production [034] - Sponsor Talk

M. Martinez Castillero*

Beta Bugs Limited

A key challenge in commercial breeding programmes is bridging the gap between nucleus-level genetic gains and real-world performance at multiplication level. While improvements in performance at nucleus level are often reported, their commercial relevance depends on consistent expression of these traits in multiplication environments.

This study aimed to demonstrate the impact of selective breeding on Black Soldier Fly performance across nucleus and multiplication settings, highlighting the transition from genetic development to scalable product delivery. A selected line was benchmarked against a non-selected line under controlled (nucleus) and commercial-scale (multiplication) conditions. At nucleus level, the selected line demonstrated a 24 % increase in individual body weight at day 14, the target trait used to reflect key growth performance relevant to producer objectives. Under multiplication conditions, performance was measured by pupae mass as an indication of overall mass increase. Following an initial acclimation period, results showed the selected line outperformed the non-selected line by 30.5 % in pupae yield. These findings confirm that selective breeding benefits can be realised at multiplication scale and are not solely confined to laboratory or pilot settings. As a result, we demonstrate a crucial step forward in BSF production, offering a commercially viable route to improve productivity and efficiency through genetics-led innovation.

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Shortening the black soldier fly life cycle by temperature-driven genetic selection [040]

P. García-Castillo*, L. Hernández-Pelegrín, C. Peralta, and S. Herrero

University of Valencia (UV)

The high energy requirements associated with maintaining optimal insect growth conditions is a central challenge for the insect mass rearing industry. Among the species currently used, the black soldier fly (*Hermetia illucens*, Diptera: Stratiomyidae) stands out due to its remarkable efficiency in converting organic waste into high-value feed ingredients. In this context, the selection and breeding of insect lines capable of growing at higher temperatures represent a promising strategy to enhance the economic and environmental sustainability of insect-based protein production.

By selecting larvae for fast growth at 35 ˚C, we obtained a colony (Sel35) that has a faster cycle at 35 ˚C but also at 28 ˚C. After twenty-four generations, the selected strain presents a reduction in the reproductive cycle of about 5 and 3 days at 28 ˚C and 35 ˚C, respectively when compared with the non-selected strain (Ento2) under the same conditions. Additionally, Sel35 strain showed a significant increase in female fertility and higher prepupae weight - associated with water accumulation at 35 ˚C - without negative effects on other tested biological parameters. Changes in the microbiome composition was further evaluated as responsible of the selected traits, revealing that rearing temperature, but not the selection, as the main driver of the observed differences in microbial composition.

Our results reveal the potential of BSF breeding for the generation of new strains with improved properties contributing to a more sustainable and cost-effective insect production.

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Functional analysis of gene family evolution demonstrates expansion of digestive, immunity and olfactory functions in the black soldier fly (*Hermetia illucens*) lineage [057]

W. Zhou*, D. Kunz, and C. Jiggins.

Department of Zoology, University of Cambridge

Structural variants such as chromosomal rearrangements and gene duplications can play an important role in the adaptation and diversification of organisms. Here, we used comparative genomics to study the functional implications of structural variants across two families of flies. We compared the reference genomes of eight Asilidae species and six Stratiomyidae species, including the black soldier fly (*Hermetia illucens*), a species with an ability to convert organic waste into biomass and a recently expanded global range. The genomes of Stratiomyidae are generally larger than Asilidae and contain a higher proportion of transposable elements, many of which are recently expanded. Gene families showing more gene duplications are enriched for life history related functions such as metabolism in Stratiomyidae and proteolysis and longevity in Asilidae. Gene families showing more gene duplications that are specific to *H. illucens* are mostly related to olfactory and immune responses, while across the Stratiomyidae there is enrichment of digestive and metabolic functions such as proteolysis. Together, our results shed light on gene family expansions that have likely played a role in the ecological success of the black soldier fly.

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Enzyme duplication and neofunctionalization is a dominant mode of evolution in *H. illucens* [009]

D. Kunz*, M. Penner, W. Zhou, F. Hollfelder, and C. Jiggins

University of Cambridge

Metazoan genomes represent a vast resource for the discovery of novel biocatalysts. Here we develop an approach for high-throughput functional screening of enzyme activity. Using cDNA libraries from the black soldier fly (*Hermetia illucens*) we identified promiscuous enzymes with novel catalytic capabilities. Specifically, we identify a distinct clade of glycosylhydrolases recently expanded in *H. illucens* and capable of degrading both alpha- and beta-linked glycosides, as well as various sugars—including glucose, fucose, rhamnose, and arabinose—in both furanose and pyranose forms. Notably, no prior glycosidase has demonstrated such dual specificity. Our findings therefore demonstrate how functional screening of eukaryotic cDNA libraries can unveil novel enzymatic diversity. We screen for substrate specificity across the gene family and demonstrate how tandem gene duplication and subsequent amino acid substitutions have driven rapid divergence in catalytic activity. Our results show how transcriptome-based functional screening complements metagenomics, revealing untapped genetic potential within metazoan genomes and provide some of the first insights into the enzymes underlying the diverse diet of the black soldier fly.

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Microbial volatiles in black soldier fly oviposition [014]

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The black soldier fly (BSF) industry is developing rapidly. BSF rearing systems range from small-scale home production to large-scale facilities. However, the large-scale production of high quantities of fertilized eggs remains challenging. Here, we focused on the influence of microbial volatile organic compounds (mVOCs) on BSF oviposition. To investigate this influence, we combined egg-laying bioassays with semiochemical, microbiological, and genetic analyses. Attraction experiments with various organic substrates revealed a preference of BSF females for fresh chicken manure. Microbes were isolated to characterize the microbiome of chicken manure and link the mVOCs they produce to the oviposition preference of BSF females. Since microbial cultivability on artificial nutrient media is very limited, we chose a dual cultivation approach using standard on-plate cultivation and the isolation chip (iChip). Complementary metabarcoding was used to profile the microbiome and compare the congruence of cultivation methods. Cultured microbes were identified via Sanger sequencing and the mVOCs they produced were analyzed using gas chromatography-mass spectrometry (GC-MS). This study shows that a combination of microbial cultivation approaches is important to understanding insect-microbe communication pathways and signals and gives first insights in mVOCs involved in BSF oviposition.

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A Perfect Soldier: the black soldier fly as a microbial-mediated physiological resilience model [068]

Hunter K. Walt[1], Michael B. Smith[2], Erin Harris[3], Sienna McPeek[3], Florencia Meyer[1], Spencer T. Behmer[3], Federico G. Hoffmann[1], Jeffery K. Tomberlin[3], Christine J. Picard[2,], and Heather R. Jordan[1*]

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The black soldier fly is a globally recognized insect with potential for sustainable waste-to-nutrient conversion. While black soldier fly larvae thrive on various organic substrates, the interplay between dietary macronutrient composition, host physiology, and microbial communities is underexplored. We conducted a study to investigate the complex, tripartite relationship between the black soldier fly, its diet, and its gut microbiome by examining how different dietary protein-to-carbohydrate (P:C) ratios affect host physiology, gut microbiota, and overall performance. Black soldier fly larvae were reared on three formulated diets: carbohydrate-biased (1P:5C), balanced (1P:1C), and protein-biased (5P:1C). Life-history data revealed that the balanced diet led to optimal growth and survival, while the carbohydrate-biased diet delayed development and reduced larval weight, while the protein-biased diet resulted in higher mortality. At the molecular level, both host and microbial transcriptomics showed diet-dependent changes. The carbohydrate-biased diet promoted higher microbial diversity and increased expression of genes related to carbohydrate metabolism in the gut microbiome. However, this correlated with negative impacts on larval performance, suggesting a potential trade-off or host control over its microbial community. Host transcriptomic analysis further revealed shifts in gene expression related to digestion, metabolism, and immune function, with the carbohydrate-biased diet upregulating immune responses. These findings highlight the importance of precise dietary formulations for optimizing insect nutrition and demonstrate the black soldier fly's utility as a model for exploring the intricate host-diet-microbe axis.

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The circular shift: BSF as the building brick for regenerative farming [060] - Sponsor Talk

O. Jebens*

Refarm Global Investments LLC, Dubai, UAE

The Black Soldier Fly (BSF) industry originated with a bold vision: to convert organic waste into high-value protein and oil for the animal feed and agriculture sectors. BSF larvae are uniquely efficient at transforming low-grade biomass into nutrient-rich inputs, making them an attractive solution for addressing both waste and protein shortages.

However, the sector has faced persistent challenges in scaling. Inconsistent and contaminated waste streams, complex regulatory landscapes, and the logistical difficulty of supplying feed markets at volume and competitive pricing have slowed progress.

Today, a strategic shift is underway. Rather than viewing BSF simply as a waste disposal method or a feed ingredient supplier, the industry is beginning to position BSF within larger circular economy systems, where the conversion of waste into protein and oil is optimised, decentralised, and locally responsive.

In this model, protein and oil remain the central value drivers, but the pathway to delivering them is more flexible. BSF operations are being designed around available waste resources, with waste reduction seen as an enabler, not the end goal. The result is a more resilient and modular industry, one where high-quality protein and oil are produced closer to the point of consumption, reducing supply chain friction and increasing traceability.

By integrating BSF into localised ecosystems, alongside complementary technologies such as composting or anaerobic digestion, the industry can unlock economically viable, scalable models that deliver both sustainability and commercial value. Refarm Global Investments LLC exemplifies this next-generation approach. Through its “Decarbonise to Recarbonise” mission and the development of the GigaFarm project in Dubai, Refarm is integrating BSF alongside complementary technologies in energy, water, and regenerative food solutions. The project is aligned with global climate goals and the UAE’s National Food Security Strategy 2050, demonstrating how BSF can be leveraged not just as a protein replacement, but as a cornerstone of climate-resilient food production systems.

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Decoding the Indian Black Soldier Fly Genome: Molecular Signatures and Evolution of Immune Peptide Cascades [013] - Sponsor Talk

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The Black Soldier Fly (*Hermetia illucens*) has emerged as a global flagship species for biowaste valorization and sustainable protein production. Yet, despite rapid industrial adoption, genomic resources remain dominated by Euro-American reference lines, limiting regional precision in bioengineering and functional feed development. In this first-of-its-kind effort, we present the high-quality, chromosome-level genome of an Indian Black Soldier Fly isolate, selectively bred for enhanced antimicrobial peptide (AMP) output and tropical adaptability.

The genome spans 1.4 Gb, with a scaffold N50 of 12.3 Mb and a GC content of 42%, revealing 16,076 coding genes—of which 13,121 are functionally annotated. Variant profiling against global reference strains uncovered 47.33 million variants (41M SNPs, 7M INDELs), with functional annotation highlighting unique expansions in immune effectors (AMPs: defensins, cecropins), detoxification genes (cytochrome P450s), and olfactory receptors. Notably, the Indian isolate exhibits significant copy number amplifications in AMP loci—outpacing global counterparts—implying regional genetic adaptations to high microbial load environments.

As India leads the charge toward decentralized, circular bioeconomy solutions, this genome sets a new standard for regionally adapted insect biotechnology—redefining global reference models and empowering next-generation functional ingredient platforms.

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Identification, recombinant production, and phenotypic screening of antimicrobial peptides from *Hermetia illucens* [011]

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The world faces a major infectious disease challenge, exacerbated by rising levels of antimicrobial resistance (AMR). New therapeutic modalities are desperately needed, with increasing attention being paid to the potential of antimicrobial peptides (AMPs). These exhibit low resistance rates and rapid antimicrobial activity.

Hermetia illucens, feed on decaying matter rich in bacteria and have the largest number of AMPs identified in insects, some of which can be induced by feeding on a diet with bacteria or using different organic substrates. Most AMPs identified in *H. illucens* have not yet undergone antimicrobial evaluation but are promising leads to treat infections.

We have identified, cloned, expressed, and purified 9 putative AMPs from *H. illucens* and performed initial in vitro experiments to evaluate their antimicrobial activity.

The presentation will focus on (i) the putative attacin Hill_BB_C10074, predicted to form a homotrimeric 12-stranded beta-barrel protein that may function like Gram-negative bacteria porins, with anti-Pseudomonas aeruginosa activity, and (ii) a putative novel defensin, Jg7904.t1, encoded in a paralogous gene cluster, with activity against P. aeruginosa.

In summary, Hill_BB_C10074, Jg7904.t1 (and other putative AMPs identified from *H. illucens*) should be tested against a broader panel of bacteria and be considered for further phenotypic screening and development.

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A solinvivirus induces cellular antiviral response and reduces the lifespan of adult *Hermetia illucens* (black soldier flies) [044]

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Viral pathogens pose an emerging threat to the sustainability of insect mass-rearing systems, yet remain understudied in key species like the black soldier fly (BSF, *Hermetia illucens*). While previous research has identified multiple viral sequences associated with BSF, their etiological role in disease had not been established. Here, we present the first in vivo characterisation of a virus not only shown to infect, but also to cause disease in BSF. Using a metatranscriptomic approach on samples from a commercial colony exhibiting early adult mortality and reduced fecundity, we detected high levels of viral RNA corresponding to *Hermetia illucens* solinvivirus (HiSvV), closely related to the family Solinviviridae. We successfully isolated HiSvV and developed reproducible oral- and injection-infection bioassays to study its replication, host tissue tropism, and transmission dynamics. Viral replication was confirmed in inoculated adults, and horizontal transmission between individuals was demonstrated. Infected flies exhibited significant mortality and an induced antiviral response, indicating active pathogenesis. Our findings identify HiSvV as the first confirmed viral entomopathogen of BSF and highlight the importance of viral surveillance and bioassay development in industrial insect rearing.

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Flash Talks

Temperature affects larvae differently depending on age: building a dataset for real time monitoring in BSF production [027]

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The Danish tech sector is, in collaboration with BSF growers and universities, developing solutions to optimise production. Sensors measuring temperature, moisture content, CO^2 or ammonia could be placed in growing crates to monitor the conditions inside the medium in real time, allowing day-to-day, or even hour-to-hour, adjustments of environmental growth conditions. To use real-time monitoring most effectively, a much more detailed dataset about the optimal and tolerable conditions for BSF larvae needs to be available to generate correlation models.

We grew BSFL of different ages for 48 hours in tubes submerged in water baths at slight temperature differences. Younger larvae, from neonates to at least 9 days old, were much more sensitive to low temperatures than older larvae and benefitted considerably from a stable temperature around 36-37°C, with a 2.5°C decrease lowering growth by up to one-third. On the other hand, 13-day-old larvae showed no negatives from lower temperatures. Heat stress, however, affected all aged of larvae consistently with decreased growth from 40°C onwards.

In conclusion, a reference dataset with performances of different ages of larvae could guide decisions in climate control.

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From waste to resources: Converting Canada geese feces into protein and plant fertilizer using the black soldier fly (*Hermetia illucens*) [005]

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Managing fecal waste from species in urban green spaces is vital for environmental sustainability and public health. In North America, the Canada goose is problematic due to its abundance in public spaces, causing significant droppings that harm the environment. We assessed the potential of black soldier fly larvae (BSFL) to bioconvert Canada goose feces into protein, producing frass that can be used as plant fertilizer. We conducted an experiment on BSF performance (larval growth, adult body weight, and lifespan) under three diets: a standard Gainesville diet (F0-control), a mixed diet with 50 % goose feces and 50 % Gainesville (F50), and a diet entirely of goose feces (F100). Results showed that BSFL can survive and develop in both F50 and F100, though growth rate, adult body weight, and lifespan decreased with increasing fecal concentration. We also evaluated duckweed growth across different fertilization treatments, including Hoagland's media (control) and three concentrations (2.5, 5, and 10 g·L-1) of fresh goose feces and insect frass. Duckweed grew fastest in the frass treatment at 10 g·L-1, indicating that BSFL enhances the nutritional value of goose feces for duckweed. Our study suggests that BSF can effectively bioconvert Canada goose feces into proteins while generating valuable plant fertilizer.

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Addressing variability in *Hermetia illucens* bioassays: have all the key species-specific parameters been identified? [023]

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Laboratory research on organisms is challenging due to numerous abiotic and biotic factors that must be controlled. The black soldier fly (*Hermetia illucens*) is no exception, and these factors can affect result repeatability—between research teams, experiments by the same team, and even replicates of a single experiment. While some factors like temperature and humidity are well known, variability sometimes remains unpredictable, leading to trends without statistical significance. This suggests that key species-specific parameters remain unidentified. In this context, we investigated two such parameters. The first relates to the dynamics of oviposition. In breeding cages, eggs are laid over several days, potentially producing multiple cohorts of larvae with distinct characteristics such as growth, survival, or sex ratio. The second concerns larval composition. As larvae stop feeding at the end of development, they progressively empty their digestive tracts. Collected samples therefore include individuals with varying levels of intestinal content, affecting their nutritional profile. Our work aims to better identify such influential parameters to improve experimental consistency. By refining our understanding of *H. illucens* biology, we contribute to the development of a more reliable and repeatable experimental model for this promising species.

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The Simplified BSF Approach – SIMBA: A Low-Effort BSF Solution for Smallholder Farmers and Researchers [049]

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Eclose GmbH

Operating a medium- to large-scale Black Soldier Fly (BSF) waste processing facility demands significant daily labour and coordination. However, BSF farming can also be adapted for part-time, small-scale operations requiring just a few hours per week. The SIMplified BSF Approach SIMBA follows a simple but structured schedule to make the BSF technology accessible to a broader audience, including:

- Beginners exploring BSF waste processing as a side activity or demonstration project.
- Small farms seeking to produce larvae as feed for poultry, pigs, or fish with limited resources (labour, time, money).
- Research centers requiring small-scale reproduction for studies, training, or demonstrations.

Piloted in Assam, India, SIMBA was tested over several months to evaluate performance, identify operational challenges, and refine methodologies. The results demonstrate that SIMBA can be effectively managed by farmers, cooperatives, or communities, similar to silkworm rearing or shared biogas systems. By reducing complexity and time investment, SIMBA lowers the barrier to entry for BSF adoption, promoting circular waste management and sustainable protein production in resource-limited settings.

This presentation will share key insights from the Assam trials, practical guidelines for implementing SIMBA, and its potential to empower smallholders and decentralized waste-to-feed initiatives worldwide.

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Sex determination in black soldier flies [059]

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Natural insect populations typically consist of equal proportions of females and males. Yet, commercial insect production would benefit from a bias towards females, as females are the bigger sex and lay eggs. Knowledge of sex determination is therefore important for improving insect farming. Sex in insects is determined by a cascade of genes that shows high conservation at the bottom (master switch gene) but enormous variation at the top (newly recruited instructor signals). As part of our study of the evolution and phylogeny of insect sex determination mechanisms we compare structural and sequence conservation of sex determination genes across the order of Diptera. We investigate the sex determination cascade of the black soldier fly (*Hermetia illucens*) belonging to the basal family of Stratiomyidae. We examined splicing processes, maternal mRNA provision of sex determination factors and zygotic activation across embryonic development. We furthermore report genetic variation in its sex determination genes and discuss the results in the context of altering population sex ratios via genome-editing techniques.

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FLYBREED: Efficient production of the black soldier fly through selective breeding [018]

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The aim of the FLYBREED project is to build knowledge needed to selectively breed black soldier fly (BSF) to ensure an efficient and competitive production. The project is an interdisciplinary collaboration between industry and university partners in entomology, genetics and breeding. It contains the different component needed to be able to develop an effective selective breeding program for BSF. First, we estimated economic values for important traits such as growth rate, dry mass-, protein- and fat content, development time, and larval mortality to be included in a breeding goal. We have also explored different mating systems for BSF and showed that a single male can mate up to 5 females when isolated in small cages. Genetic parameters for growth were estimated using records on individuals as well as on groups. Based on these genetic parameters, we used stochastic simulations to evaluate possible breeding programs. We simulated phenotypic selection to increase larval body weight, which was implemented in the industry. The project develops selection lines for conversion of waste products, which are tested with commercial partners. With the project, we expect the insect industry to be able to increase genetic gain for BSF traits of interest.

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Posters

Non-lethal acquisition of DNA from black soldier fly for molecular analysis [017]

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The black soldier fly (BSF) has recently received attention for its bioconversion capability of food waste and unusual organic matter and its various uses in different industrial applications.

Gene-editing provides the means to generate and/or improve specific beneficial traits of the organism in a directed and quick manner. Particularly in cases where editing efficiency is low, a method to extract fly genomic DNA and PCR while still retaining the flies' viability and fertility is crucial to identifying correctly-edited individuals from which new lines can be generated.

Here, we describe three different methods of DNA extraction: via larval haemolymph, exuviae or adult leg. We also compare the advantages and disadvantages of each method based on a) survival and fertility after extraction; b) technical difficulty; c) workflow timing. Workflow timing relates to a practical criterion – ideally the results from molecular analysis would be available before the individuals being analysed reach sexual maturity. Obtaining the sample at an earlier developmental stage increases the time window for sample processing before this crucial point. In all the methods, extracted gDNA was sufficient to generate a 247-bp amplicon via PCR.

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Efficient lab-based rearing of BSF for engineering biology [032]

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Genetic engineering of black soldier flies (BSF) is a promising approach to enhance their application in the bioconversion of organic waste globally. The process, however, requires a large amount of time and is laborious due to the insect's long generation time and the lack of protocol for small-scale rearing in a laboratory setting, respectively. Here we describe the optimisation of methods to provide a simplified and efficient protocol to generate transgenic flies using the piggyBac transposase system.

In terms of rearing method optimisation, we assessed the overall egg production and fertility in small-group crosses from 2♀:2♂ pairs to larger groups; small-group crosses being highly desirable for isolating independent transgene insertions. To generate transgenic BSF, we separated injected G0 survivors into pools of ~20:20 G0:wild-type crosses. In our hands with the DmAct5c-hypBac helper plasmid, minimum transgene integration rates were between 2.36-7.69% (i.e. >2 transposition events/100 G0 survivors). We also inferred from the inheritance pattern that all generated isolines originated from single transposition events.

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Repurposing microbiome sequencing data for genomic diversity analysis in Black Soldier Fly [045]

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The Black Soldier Fly (BSF, *Hermetia illucens*) is increasingly recognized for its potential in sustainable protein production. However, the genetic diversity within BSF strains remains insufficiently characterized, partly due to the high cost of individual whole genome sequencing (WGS). This study explores the feasibility of using pooled shotgun sequencing data that were originally generated for microbiome analysis as a cost-effective alternative for assessing BSF genomic diversity. Both individual WGS (Illumina 150 bp paired-end) and pooled shotgun sequencing data from a total of 175 BSF individuals were analysed. Variant calling was successful across datasets, yielding an average of 4.9 million SNPs in pooled gut samples and 7.1 million SNPs in pooled whole-larval samples. Inbreeding coefficients were estimated using runs of homozygosity (ROH) and ranged between 0.05 and 0.12. ROH islands identified in the pooled data overlapped with known domestication signals, for example on chromosome 5. Additionally, the potential to repurpose WGS data for basic microbiome profiling was evaluated, revealing limited but promising insights. These findings demonstrate the dual utility of sequencing datasets for both host genomic and microbiome analyses, offering a practical approach for genetic monitoring and resource optimization in BSF research and breeding programs.

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Decoding microbial influence in black soldier fly oviposition [051]

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Directed oviposition of fertile eggs is essential for scaling up insect biomass production. However, the role of microorganisms and microbially produced volatile organic compounds in guiding female flies to optimal oviposition sites remains underexplored. Here, we investigated how microbe-emitted chemical signals enhance oviposition behavior in black soldier flies (BSF), and how their potential can be exploited in artificial settings using synthetic attractants. To identify the most attractive substrate for BSF oviposition, we presented substrates to adult flies in Petri dishes with perforated lids allowing the release of odorants through an attached egg trap. After identifying chicken manure as the most attractive oviposition substrate and analyzing it comprehensively, we aimed to evaluate whether this preference was also beneficial for other BSF developmental stages. The same substrates used in oviposition experiments were fed to the larvae to determine their effects on development. The preferred substrate from the initial experiment did not support optimal development at any stage but slowed the transition from larval to pupal stage, leading to the highest larval mortality, smallest adult flies, no oviposition, and thus no reproduction. Such studies are vital to advancing our understanding of economically relevant insects and refining their breeding for broader applications.

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Chitin Extraction from Black Soldier Fly (*Hermetia illucens*) Using a Conventional Chemical Method [041]

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Black soldier flies (*Hermetia illucens*) (BSF) offer ways to address the challenges of food waste management and the increasing need for biomaterials, changing waste into valuable byproducts such as protein, chitin, fertilizer, and melanin. This study focuses on the extraction of chitin from adult BSF using a conventional chemical method (1M NaOH, 1M HCl, and H_2O_2), evaluating its efficiency and product quality against Zhou et al.[1] Natural Deep Eutectic Solvents (NADES) extraction from skimmed BSF prepupae using various choline chloride-based NADES (with urea, glycerol, lactic acid, oxalic acid, n-butyric acid). The results show that the chemical method was highly effective in the removal of protein and minerals, high-purity α-chitin with a yield of 6.17 %, while Zhou et al. reported higher yields ranging from 12 % to 26 %. Thermogravimetric analysis (TGA) showed similar decomposition profiles, although the chemically extracted chitin exhibited a slightly higher maximum decomposition temperature (379.3 °C vs. 323.1 °C). X-ray diffraction (XRD) analysis revealed higher crystallinity in the chemically extracted chitin (65.5 %) compared to the NADES-extracted samples (31.34 %–50.76 %). Comparing outcomes suggests the extraction technique influences chitin quality and quantity. While NADES methods demonstrate potential for improving the yield of BSF, they may result in lower crystallinity and thermal stability.

1 Zhou, P., et al., (2019). Carbohydrate Polymers 225 115255.

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Mass rearing black soldier fly *Hermetia illucens* larvae year-round in a Mediterranean greenhouse [048]

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Black soldier fly (BSF) *Hermetia illucens* (L.) (Diptera: Stratiomyidae) has gained attention for its ability to upcycle nutrients from agri-food residues into animal feed and organic fertilizer in a circular, zero-waste scheme. In temperate climates, where BSF farming often relies on hi-tech facilities with tight temperature control, the associated energy consumption curbs its cost-efficiency and environmental benefits. In contrast, subtropical climates allow for low-tech, low-cost, energy-efficient BSF farming. We assessed the potential of mass-rearing BSF larvae year-round in a Mediterranean greenhouse. Larval growth experiments were conducted in industrial rearing trays using brewers' spent grains. Fifteen experiments involving 100 trays were performed in an experimental greenhouse in Crete, Greece at the facilities of Magma Agro S.A.. The climate control system was comparable to a typical Greek horticulture greenhouse. Despite strong temperature variability, larval growth was comparable to tightly controlled settings. Higher rearing densities, associated with lower feed availability per larva, resulted in lighter larvae but larger total harvestable biomass. Feed dry matter availability was the strongest predictor of growth and bioconversion efficiency, while temperature had no significant effect. Projected energy and cost savings demonstrate the potential of BSF farming in this rural context.

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Farmers' Preferences for Larval Traits in Small-Scale Black Soldier Fly (*Hermetia illucens*) Production System [019]

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Black soldier fly (BSF) rearing supports small-scale production systems in East Africa by providing alternative protein and organic fertilizer, but challenges such as low nutritional quality, inconsistent production, and low biomass yield hinder its potential. Selective breeding can address these challenges, but despite its importance, there is no prior study for low-input production systems. This study investigates trait preferences of small-scale BSF farmers and their willingness to pay (WTP) for an improvement of a trait. Using a discrete choice experiment, we collected socioeconomic and trait preference data from 212 farmers across 11 districts in Uganda. A Random Parameters Logit (RPL) model was fitted to estimate coefficients of preference and WTP. Results indicate that 61% of farmers are women, located in central Uganda. Despite individual heterogeneity in trait preferences, the most preferred traits were high organic waste decomposition efficiency (coefficient = 0.79 ± 0.14) and protein content (0.56 ± 0.08), followed by survival rate (0.31 ± 0.07) and larval size (0.28 ± 0.07). Farmers are willing to pay for the traits they valued. Longer development time and increased price reduced utility. Preference heterogeneity indicates that farmers prioritize different traits based on their production contexts, indicating the need for flexible breeding programs.

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Utilizing RGB Imaging and Machine Learning for Remote Weight Assessment in Black Soldier Fly Larvae within a Circular Economy Framework [050]

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The increasing global demand for sustainable food production has driven interest in alternative protein sources, with black soldier fly larvae (*Hermetia illucens*) emerging as a viable candidate. This study aimed to develop a non-invasive phenotyping method, with the case study of weight estimation model for black soldier fly larvae, using RGB imaging and machine learning techniques.

The research highlights the integration of RGB imaging with machine learning algorithms to facilitate accurate monitoring of larval growth and health, by using visual parameters that can be analyzed and their connection to growth parameters, such as larvae weight and tray distribution. This innovative approach enabled continuous monitoring of larval growth without disturbance, aligning with ethical considerations in animal research. Overall, this study underscores the effectiveness of non-invasive methodologies in assessing black soldier fly larvae, contributing to sustainable agricultural practices and resource efficiency within circular economy frameworks. The findings not only enhance scientific understanding of black soldier fly larvae development but also support broader sustainability goals in food production systems. By providing a robust framework for monitoring insect farming practices, this research paves the way for future studies aimed at optimizing alternative protein sources and enhancing food security in an evolving global landscape.

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No Gains on Gainesville: A 15-Generation BSF Experiment [010]

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The black soldier fly (BSF) is known for it's capability to convert a vast array of organic side streams to high quality animal proteins. However, the efficiency at which it converts this matter is vastly different depending on the feed properties. Our hypothesis was that if reared for multiple generations on a certain feed, the larvae will become more efficient. This is because of natural selection: larvae that are more efficient will be larger, and larger larvae result in larger flies which in turn result in more offspring.

In this experiment our in-house BSF population that was historically reared on chickenfeed was split in two. One part was, as previously, reared on chickenfeed while the other part was reared exclusively on Gainesville diet for 15 generations. In contrast to what was expected, we did not observe any changes in efficiency for the Gainesville diet over those generations. At the end the populations were mixed again, yet again there were no significant positive or negative changes in efficiency. Follow up research is needed to determine why our initial hypothesis was incorrect.

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A Community Analysis of Plastic-Fed Black Soldier Fly Larvae Gut Microbiota [043]

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Black soldier fly larvae (*Hermetia illucens*), BSFL, and their associated gut microbiota have generated interest due to their ability to degrade human-made wastes, such as plastics. However, not much is known about the microbial interactions involved in this process and how these plastics are broken down into simpler forms. Here, we have compiled publicly available BSFL gut microbiome datasets for ecological network construction to characterize these potential microbial interactions. Network stability and robustness were assessed by rank-ordering taxa based on how frequently they assist in connecting pairs of taxa and sequentially removing them to simulate community species loss. Differential abundance analysis found taxa, such as Luteolibacter, more differentially abundant in plastic-fed samples than the control diets, implying a potential role in plastic degradation. Network analysis found that specialized diets like plastic wastes had a fewer number of subnetworks that remained stable as taxa were removed, leading to a decreased overall robustness compared to more diverse diets such as plant wastes. This indicates that specialized diets may select for microbial guilds that are less adapted for environmental shifts. Future research will be aimed to profile the microbial guilds responsible for degrading plastic wastes and what metabolic interactions drive these processes.

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Exploring the Potential of Black Soldier Fly Compost Tea for Weed Suppression [006]

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Weeds present a significant challenge in agriculture by reducing crop yields and demanding frequent control measures. Black soldier fly (*Hermetia illucens*) compost tea, produced from digested organic waste, has garnered recent interest as a soil amendment due to its unique chemical and microbial properties. While studies have examined its role in improving soil health, its potential phytotoxicity and effect on weed suppression remain underexplored. In 2024, laboratory studies were conducted to evaluate the impact of black soldier fly compost tea on the relative seed germination (RSG) of barnyardgrass (*Echinochloa crus-galli* L.), velvetleaf (*Abutilon theophrasti* L.), and redroot pigweed (*Amaranthus retroflexus* L.). Dried black soldier fly compost (frass) was mixed with distilled water (0.25 g ml^{-1}), shaken for 30 minutes, and steeped for 24 hours. The 1:5 compost tea was diluted into a dose-response series: 0.03, 0.06, 0.09, 0.12, 0.15, 0.18, and 0.20 g ml^{-1}. Twenty seeds per species were placed in petri dishes and treated with 3 ml of each dilution. Dishes were incubated at 30°C/18°C (day/night) with a 14-hour light photoperiod for two weeks, and germination was assessed 7 and 14 days later. All three weed species exhibited a dose-dependent decline in RSG. For barnyardgrass, RSG decreased from 100% in the control to 2.8% at 0.12 g ml^{-1} and 0% at higher concentrations. Velvetleaf and pigweed both showed strong sensitivity, with RSG dropping below 30% at just 0.03 g ml^{-1} and reaching 0% by 0.06 g ml^{-1}. Three-parameter logistic models were fit to the RSG data, and the estimated dose to reduce germination by 50% (ED_{50}) was 0.039 g ml^{-1} for barnyardgrass, 0.030 for velvetleaf, and 0.025 for redroot pigweed. These results suggest that black soldier fly compost tea may act as a low-input, eco-friendly weed suppression tool. However, additional studies are needed in situ to determine if the results from this trial are applicable to field conditions.

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Effect of Black Soldier Fly Larvae and Food Substrates on Weed Seed Emergence [050]

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Black soldier fly larvae (BSFL) composting is a biotechnology for organic waste management that offers an alternative to traditional composting. We conducted a two-phase experiment to evaluate BSFL composting effects on emergence of six weed species: barnyardgrass, common ragweed, giant foxtail, ivyleaf morningglory, redroot pigweed, and velvetleaf. In the laboratory phase, 100 seeds of each species were subjected to five treatments: two controls (nontreated and standard Gainesville diet alone) and three BSFL substrates (standard Gainesville diet, vegetable waste, and food waste). Live pupae weighed 179 mg with the standard diet + BSFL and 205 mg with food waste + BSFL, while dry pupae weighed 68 mg and 70 mg respectively. BSFL in the vegetable waste treatment failed to pupate. In the greenhouse phase, weed emergence was evaluated. Nontreated control emergence rates were: barnyardgrass 62 %, common ragweed 38 %, giant foxtail 26 %, ivyleaf morningglory 66 %, redroot pigweed 3 %, and velvetleaf 69 %. All BSFL treatments reduced emergence to ≤1 % for most species, except velvetleaf. BSFL composting effectively reduces weed seed emergence and could provide a safer alternative to conventional composting for minimizing weed pressure. However, efficacy varies by species and may depend on seed characteristics like impermeable seedcoats.

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Evaluating the potential of three insect-derived soil amendments on plant glucosinolate production [037]

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Brassica crop production is plagued by a variety of insect pests, causing aesthetic damage and plant death, leading to economic losses for farmers. Plant resistance to herbivores is influenced by soil conditions, nutrient availability, and frequently herbivore identity; however, the impact of insect-derived amendments in enhancing this resistance remains poorly understood. Limited studies suggest that organic amendments may increase glucosinolate levels- key defense compounds in brassicas- but few have specifically reported the effects of insect-derived amendments on plant glucosinolate content. Here, we assess the application of three insect-derived soil amendments on bok choy production: cricket frass, BSF frass, and pupal cases from BSF production. Through a greenhouse bioassay and laboratory analysis, we evaluated the impacts of these three amendment sources on resistance against two insect herbivores plaguing bok choy: the generalist aphid, *Myzus persicae*, and the specialist caterpillar, *Trichoplusia ni*. We measured plant weight, insect weight, insect population density, and glucosinolate content in plant tissues. The results of this experiment will help to understand the relationship between insect-derived amendments and plant resistance in brassicas. Additionally, this research will be presented and discussed in the context of sustainable food production, pest management, and the potential of circular economies around insect production.

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