PREFACE: Black soldier fly (BSF) *Hermetia illucens* is a species of great economic importance for many reasons. It has the ability to transform various types of organic wastes into valuable proteins and organic fertilizer. The larvae of this fly feed on decaying matter. The adults are neither pests nor vectors of disease. The flies are highly resistant to insecticides and can tolerate a wide range of pH, thus making them winning competitors in fields treated with pesticides. Mass production of BSF as a novel source of protein for poultry, fish and other animal feed production would lead to the creation of several new jobs for the youths and women in our communities.
Encouraging the use of BSF farming can be a model of business incubation that will support various fields of development in an organic and chemical free environment.

Prof. Dr. M. Yussouf Saleem
Director, NIAB

MULTIPLE USEFUL ROLES OF BSF

(I) WASTE MANAGEMENT: A large amount of biowaste is generated in urban markets, particularly in fruit and vegetable markets. By-products produced by slaughterhouses after slaughtering animals, such as blood, intestines, and feathers, are often underutilized and generate additional waste sources. As a result, biowastes accumulate in open and unregulated sites, creating unsanitary environmental conditions that pose public health risks and contribute to greenhouse gas (GHG) emissions.

Black soldier fly larvae have been widely used to recycle animal tissue and other waste products. Because of this ability, black soldier fly is considered as a recognized agent for sustainable recycling of animal wastes and plant materials. Larvae of the black soldier fly can reduce dry matter in such waste by 50%.

(II) FEED FOR INDUSTRY: Fish and plant protein sources are commonly used protein sources in feed industries, which are directly and indirectly competing with human nutrition. Farming BSF as innovative cost-effective and eco-friendly options for alternative novel protein source for livestock is crucial. BSF are rich in crude protein (40-50%), fatty acids, amino acids, vitamins, chitin, flavonoids etc. hence are a great source of animal protein and a preferred substitute of fishmeal, soybean meal etc. In addition, when produced on bio-waste, insect-based feeds can be more sustainable than conventional feeds.

(III) FRASS AS NATURAL FERTILIZER: Black soldier fly larvae (BSFL) act as decomposers in breaking down organic substrates and returning nutrients to the soil. Black soldier fly frass fertilizer (BSFFF) is increasingly gaining momentum worldwide as organic fertilizer. Frass is the left-over product from growing black soldier fly larvae (BSFL), including larvae waste, exoskeleton sheds and feed ingredients remainants. This all-natural fertilizer contains a nutrient dense blend of N-P-K, minerals and chitin. The N-P-K value (Nitrogen –Phosphorous – Potassium) level is roughly 2% – 1% – 2%, and as such is ideal for horticulture and organic matter is > 80%.Composting with Black soldier flies is more efficient because larvae feed on all kinds of biodegradable matter, super-fast and efficient.

(IV) SOURCE OF CHITIN FOR SUSTAINABLE AGRICULTURE

Chitin in BSF frass is derived from exoskeleton of BSF and its derivatives are recognized as promising soil amendments for improving soil quality, induce abiotic and biotic plant stress tolerance, boost defense mechanism of plants against microorganisms, elicit the production of secondary metabolites, and protect the safety of edible products. The fertilizer effect of chitin is caused by biodegradation of the polymer in soil into ammonia which promotes the growth of selected microorganisms and improves plant defense by inhibition of the pathogens. Moreover, it is an effective edible coating material for postharvest fruits.

(V) BIOFUEL: Black soldier fly larvae are rich in lipids and can be used to produce biofuel. During the larval stages, BSF larvae can produce 70% extractable oil. The extracted lipids from BSFL are mainly composed of saturated fatty acids (SFFA) and have been used as in the production of biodiesel.

(VI) REDUCED GREENHOUSE GASES AND CLIMATE CHANGE

BSF technology can significantly reduce greenhouse gas emissions compared to traditional composting processes. Larval and bacterial activities can not only reduce the dry matter, but also other components such as nitrogen and phosphorus. These flies have been observed to reduce total nitrogen concentration by 62% in manure recycling and thus methane formation.

DEVELOPMENT OF PRODUCTS FOR COMMERCIALIZATION:

NIAB CHITO-COMPOST: Black soldier fly frass fertilizer (BSFFF) is an organic fertilizer, which is a left-over product from growing black soldier fly larvae (BSFL). It contains larvae waste, exoskeleton sheds and remaining feed ingredients. This natural fertilizer is ecofriendly and contains a blend of N-P-K, minerals and

chitin. The N-P-K value is (2% – 1% – 2%) and Chitin in the BSF frass is likely to benefit crop by improving resistance to plant pathogens. with

NIAB FLOW GREEN: This is a liquid organic fertilizer developed from growing BSF larvae. During the process of decomposition of organic waste by BSF, liquid compost tea is formed. This can be separated from the larval culture and used as liquid fertilizer for aquaponic culture and foliar applications. Macro nutrients (N, P, K) analyzed for tea compost showed satisfactory 2.04% N, 1.5% P and 2.3% K respectively.

NIAB BSF GRUB PROTEIN: The product that contains BSF larvae in dry form, which is a rich source of protein, fats and other misronutrients for good health of birds and fish. BSF grub protein contains higher amount of essential amino acids required for growth and development of organisms.It is used for aquaculture, poultry and fancy bird production. The larvae of BSF will cater the requirement of protein source for feed industries.

NIAB BSF EGGS AND PRE PUPAE: The BSF Pre-pupae and eggs (alive) are available as a seed culture for the establishment of small as well as large scale BSF rearing facility.

COLLABORATION AND TRANSFER OF TECHNOLOGY

NIAB is looking forward for collaboration with government, municipal department, feed and fertilizer industry, stakeholders and farming community for embarking opportunities towards the achievement of sustainability in feed and fertilizer sector with a vision of clean and green Pakistan. Furthermore, technology transfer for establishment of economical rearing system and strengthening the circular bioeconomy in the country through MoUs and contracts is also open for public and private sector.

ORGANIC FERTILIZERS

BSF PRE- PUPAE and LARVAE Protein Feed for Poultry and Fish

For further information:
Dr. Sajid Nadeem, Deputy Chief Scientist/ Head, Plant Protection Division, NIAB
Tel: 041-9201751-60 Ext. 3269
Email: sajidniab@hotmail.com

BLACK SOLDIER FLY

(*Hermetia illucens*)

A MULTI INDUSTRY INSECT

Prepared by:

Dr. Nazia Suleman, Deputy Chief Scientist
Ms. Asia Riaz, Principal Scientist

Plant Protection Division
Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad
Pakistan Atomic Energy Commission