

### ***Rearing Black Soldier Fly in pilot scale in RIBE***

Under the Collaborative Research Agreement between Research Institute for Biotechnology and Environment (RIBE), Nong Lam University and CJ Cheiljedang Corporation (CJ) for “Research of BSF Feeding and Management” involving BSF feeding development, the BSF house was built in RIBE. Which the area is about 208 m<sup>2</sup>, consists of 3 parts: larva area, adult area and food storage area. There are 3 air conditioners, 8 lights, 5 exhaust fans, 5 fans, a freezer store, a dried oven, a humidifier and a pray machine, a food mixer and 300 boxes.



*Figure 1. BSF House (pilot) in RIBE*

The larvae area is 128 m<sup>2</sup> and there are 2 air-conditioners are set up at 28 °C, 4 fans, 4 exhaust fans, 6 lights are turned on at 8 am and turn off about 6 pm, 12 shelves- can keep 144 boxes, a food mixer and weigh.



*Figure 2. Inside the Larvae area*

The size of the adult area is about 24 m<sup>2</sup>, but the size of the net house is about 14 m<sup>2</sup>. There are: a light, Air conditioner is set up at 27°C, a fan and an exhaust fan always activity. A pray machine is put above the net. It activates from 10 am to 16 pm with frequency 5 minutes/hour. A humidifier is put outside of the net house and is set up at 60% of humidity. The

net house is divided to 2 houses: A house and B house. Each house has a laying medium and can hold 30 pupa boxes. Putting 2 trees on each house to adult fly cling and regulate the air.



Figure 3. Inside the net house for BSF Adults

The pilot operated in the January 2017 and stable operation from February until December. Producing about 6,901 kg BSF larvae and 814 kg dried BSF larvae (is not including the larvae input to net house 5 kg/day (1,825 kg). The adult net house produced 5011.49 g eggs (from 3/2017 -12/2017)

#### Description of the Black Soldier Fly in RIBE pilot

Due to the temperature condition in pilot is setup at 28 °C (25 – 30 °C) and humidity around 90 %. The whole life cycle of *Hermitia illucens* passes five stages (egg, larva, prepupa, pupa and adult) in about 35 – 40 days (figure 4). The longest part of their life cycle is spent in their larval and pupal stages (21 – 25 days), whereas their egg and adult stages are relatively shorter (2 - 3 days for egg stage and 5 – 8 days for adult stage).

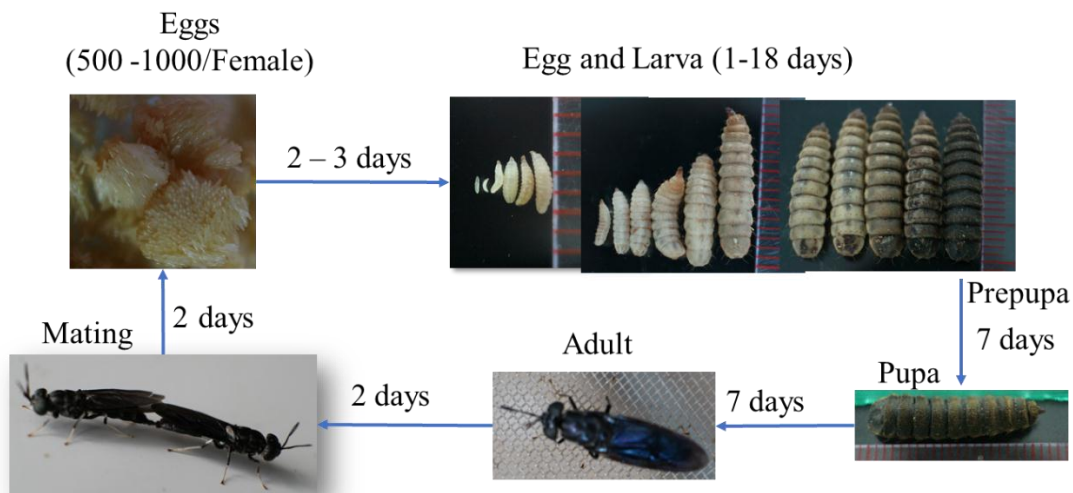


Figure 4. Cycle life of Black Soldier Fly in RIBE pilot

Two days after adult emergence from the pupal case, mating is occurred. A male black soldier fly intercepts a passing female in mid-air and they descend in *copula*. After mating After mating, a female adult lays her eggs in cracks and crevices which are separated a bit from the food source (figure 5). Each female is capable of laying clusters of between 500 and 1000 eggs.



*Figure 5. Adult female BSF lays her egg on the foam flower*

In pilot environmental conditions, once laid, the eggs were hatch after 48 to 72 hours. This happens to be the second stage of the life cycle when picked from the adult stage. The larval stage succeeds the egg stage. Once hatched from the eggs, larvae crawl into the food source showing the importance and need of the female adults to lay their eggs near a food source (figure 5).

The larvae stage is very important because they have to feed enough to store adequate fat which becomes the food source for adult BSF since they do not feed. The larvae have a unique composition of gut microbiota which enables them to handle a wide range of such food sources as human and animal cadavers, decaying vegetables, animal manure, palm kernel meal, municipal organic waste, fresh human faeces, and pit latrine faecal sludge. The Larvae in this pilot feed for about 16 days before becoming prepupae. Prepupae are characterized by their color change from white to dark brown as well as their tendency to migrate from the larval habitat (food source) to some other place where they can pupate from, which should ideally be a dry and dark place. The pupation stage, which is the last stage before the emergence of adult BSF, usually takes about 7 days. In the fullness of time, pupae turn into adult flies, thereby completing their life cycle as shown in figure 4.



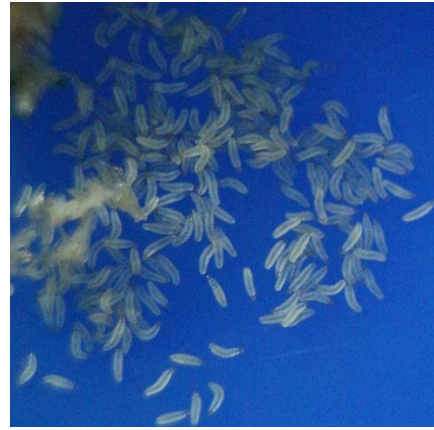
One day old egg



Egg hatching (three day olds egg) and one day old larvae



Egg hatched (Eggshell)



Egg hatched (One day old Larvae)

*Figure 6. Hatching Eggs and One-day old Larvae*