

# Post-Consumer Food Waste Management:

## Black Solider Fly Larvae Composting

Alexandra Leist, Spring 2015

Black soldier flies (BSF), or *Hermetia illucens*, are long-bodied, non-nuisance insects indigenous to North America. When in larval form, they are voracious composters that can digest all organic material. Through a pilot study at the John Gibbs Farm, we explored the potential of a population of black soldier fly larvae (BSFL) in tackling the solid waste stream produced at Bell's Brewery. Spring 2015 also was focused on comparing and contrasting the Do-it-yourself (DIY) bins to the Protapod bins, and designing an effective breeding structure to continue the BSF lifecycle.



Three experiments were carried out to compare and contrast the compost bins:

### **Experiment #1:** Waste Reduction Ratio

The waste reduction ratio is a comparison of input to output in a compost system. After all larvae reached full maturity, transitioned into pupation, and the bins were notably inactive, we harvested the bins. Harvesting takes place approximately 6 weeks after the larval population begins. A harvest consists of emptying the compost bin onto a table and sifting through the castings using our hands to separate the casting solids from any remaining pupae. We totaled the amount of input added to each bin and weighed the total amount of output per bin to calculate a waste reduction ratio. The first harvest (January 16, 2015) consisted of a wet screenings input to wet castings output ratio while the second harvest (April 10, 2015) was a wet to dry ratio. The variation in moisture was due to extended time left out and varying outside environmental conditions.

### **Experiment #2:** Temperature Needs of Larvae

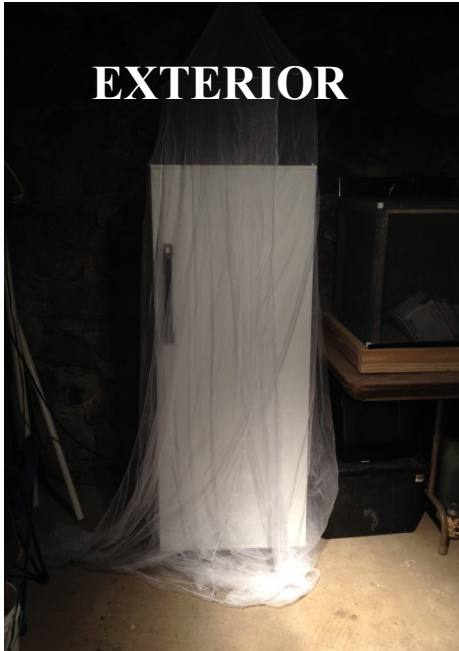
The second experiment explored the temperature needs of the larvae. Inside each bin hangs a digital sensor that records the air temperature and relative humidity of that bin. Each day the current, maximum, minimum temperature and current, maximum, minimum relative humidity are recorded from the sensors while compost pile temp is recorded with a compost thermometer.

### **Experiment #3:** Carbon: Nitrogen Ratio

In composting, the carbon to nitrogen ratio is an important factor because if it is off balance, the bioconversion gets set off balance. When there is too much carbon, decomposition slows down. When there is too much nitrogen, the compost pile becomes anaerobic and foul-smelling. BSFL prefer nitrogen rich material over carbon rich material. Since the screening solids were most likely nitrogen rich as suggested by the presence of an ammonia smell, we proceeded to add carbon in attempt to balance the ratio.

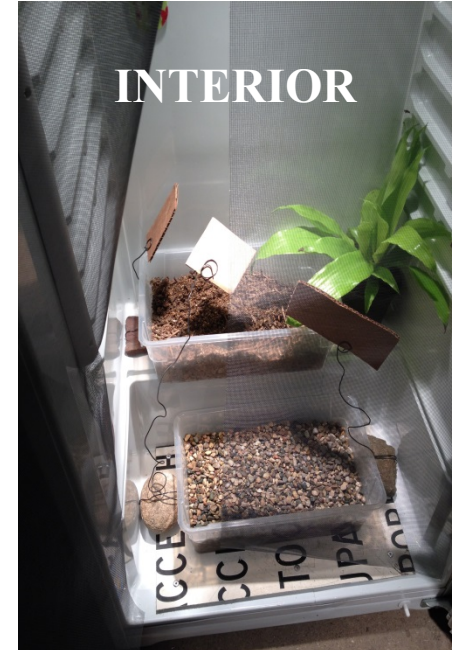
Results to each experiment will be presented in next semester's two-page report.

Another major activity involved designing, building, controlling, documenting, and troubleshooting a breeding structure for BSF's. Upon reaching full maturity, the larvae will self-harvest, or remove themselves from the compost pile to pupate. The pupae fall into a collection bucket, which then is emptied into the breeding structure. Inside the breeding structure, pupae emerge into adult flies and reproduce.



Materials used:

- Recycled 58x23 cubic inch refrigerator
- Light fixture, wire
- 60 WATT Halogen light fixture
- ½ round PVC pipe
- Window screening for ventilation holes
- Exterior netting
- Interior set-up:
  - House plant
  - Pupae bin
  - Water & gravel bin
  - Cardboard rolls
  - Interior screen
  - Digital sensors

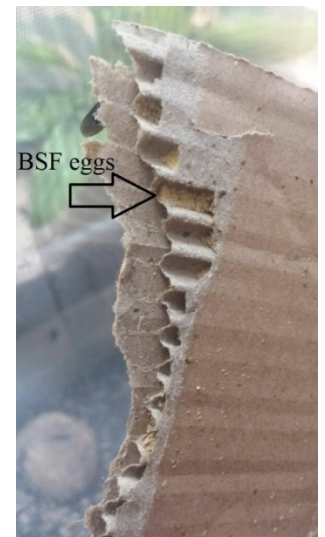


Lighting is a crucial parameter when attempting to create an artificial environment ideal for breeding. Starting with a 60 WATT halogen light bulb, we found that it was not enough. The final combination of a Zoo Med FS-C10 Reptisun 10.0 UVB provided UV light while a Bright Effects 15W CFL provided additional lumens and heat.

Adult flies mated more frequently at temperatures between 60 and 95 degrees F with relative humidity levels between 45% and 70%. The repurposed fridge held very consistent temperatures as well as relative humidity when moisture was added regularly.

We faced many challenges in effort to reproduce BSFs. A huge breakthrough with our structure was when we discovered eggs on April 3. To the right is a photo of how the eggs are oviposited. An adult female will oviposit one bundle of eggs in the corrugated holes of cardboard, laying approximately 500 eggs per bundle. Though we did have a few adult BSF's oviposit, we were unsuccessful in harnessing the reproductive portion of the BSF life cycle. We will continue to focus on the life cycle of the BSF until we can confidently say we can breed BSFs.

The upcoming months will be focused on wrapping up the Bell's Brewery project, biomimeticizing the BSFL life cycle to sustain the process, and attacking WMU's post-consumer food waste streams.



For more information on the experiments and Bell's Brewery collaboration please see the full report at:

<http://wmich.edu/sustainability/reports-publications/green-jobs-student-reports>