Artificial breeding of black soldier fly

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Introduction

The global increase in animal production requires the availability of feed inputs in quantity and quality. Current resources being limited, alternative feed productions are envisaged. Among these, local insect protein and lipid production from low value organic materials could be considered.

The black soldier fly (BSF), *Hermetia illucens* (L. 1758) has been selected as insect rearing model for feed production. The BSF larvae are polyphageouse, growth quickly and can be produced at high density. Their zootechnical characteristics allows to produce larvae by valuing a wide range of decaying organic matter. The BSF artificial rearing development requires specific methods and facilities that meet the requirements of the different stages of the species life cycle (broodstock selection, reproduction, magnification and collection). The larvae are gregarious and migrate out of substrate at the last immature stage (prepupae) to pupate and can consequently be self-harvested. The flies lay eggs in cavities near organic substrate allowing the eggs collection with artificial laying device.

Materials and Methods

1. Broodstock selection

- Mass production (10000 larvae per population)
- Magnification tanks with self-harvest system
- 3 populations (A,B,C)
- Sex-ratio assessment by manual sexing

2. Density and sex

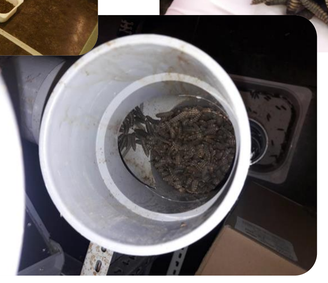
- 12h/day led illumination (27 ± 1°C – 60 ± 5% RH)
- 2 opposite sex-ratio colonies :
  (1.80 Male dominant – 0.64 Femal dominant)
- 5 charging densities (n = 3) :
  500 – 2500 – 4500 – 6500 – 8500 flies/m³
- Daily monitoring

3. Variation of the illumination period

- Luminous isolation (27 ± 1°C – 60 ± 5% RH)
- Predominantly female sex-ratio colony (6500 flies/m³)
- 4 daily illumination periods : 2 – 6 – 12 – 18h
- Daily monitoring

Magnification

Selection



Self-collection

Cage

mating

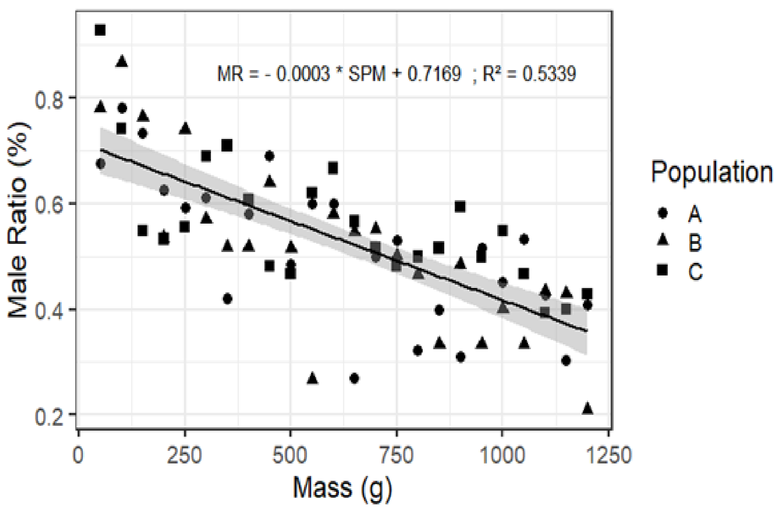
Laying device

Eggs collection

Eggs quantification

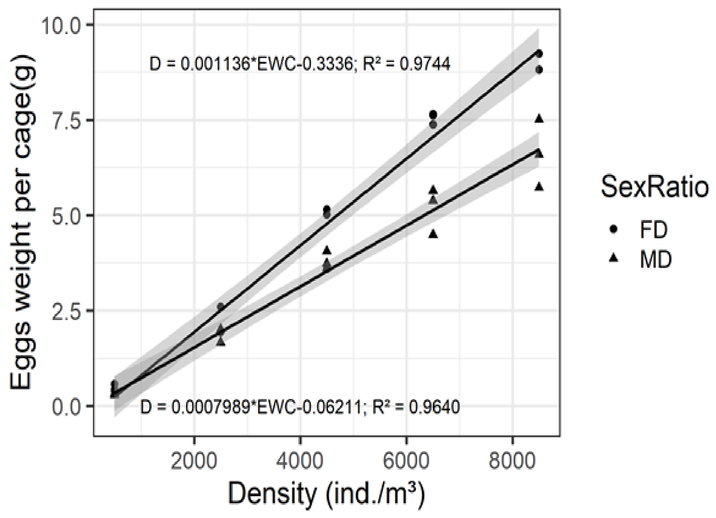
Results

1. Sex-ratio model



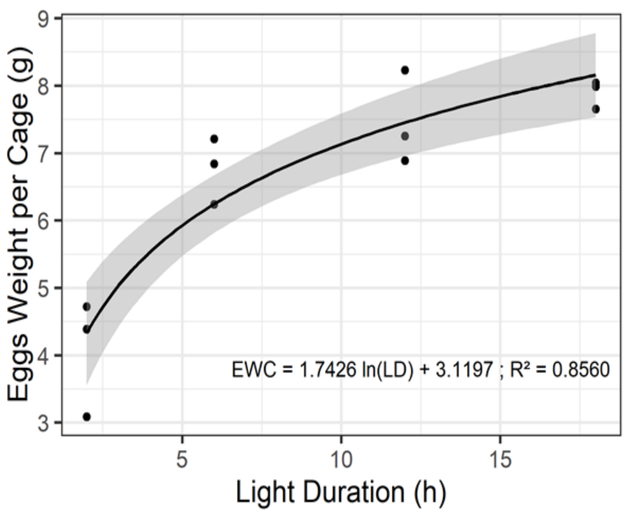
The sex-ratio of 0.5 reached at 45% of total mass of prepupae produced per magnification tank (1561.9g ± 11.1) .

2. Breeding density model



Eggs production has increased with density in the two-opposite sex-ratio with an improvement of eggs production from 6500 flies/m³ for female dominated population.

3. Nycthemeral model



Eggs production did not increase significantly from 6 hours of daily illumination.

Conclusions

1. The male ratio from self-harvested prepupae shows a shift proportion (M>F to F>M) when 45% of total prepupae weight is harvested. This model applied to a prepupae self-harvest system allows to select broodstock according to their sex-ratio.
2. The results obtained show that the reproduction limiting density in small volumes breeding cages (91125 cm³) was not reached.
3. 6 hours light duration with light intensity 40 µmol m^{-2} s^{-1} seems the minimum for BSF reproduction in an artificial breeding system.

A female-dominant prepupae population at a density of 6500 ind./m³ could be recommend to maintain a efficient BSF breeding under 6h light photoperiod.

Publication reference