

A stylized illustration of a root system in yellow-green, set against a black background. The roots are numerous and thin, spreading out from a central point at the top left towards the bottom right.

EARLY PREDICTION OF MEALWORM HARVEST

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Efficient
rearing
starts with
knowing how
many animals
you have.



Not that easy

How can we
control the
#MW or yield
in each
container?





Modelling

offspring depends on

- # adults
- Size of the container
- Days of oviposition

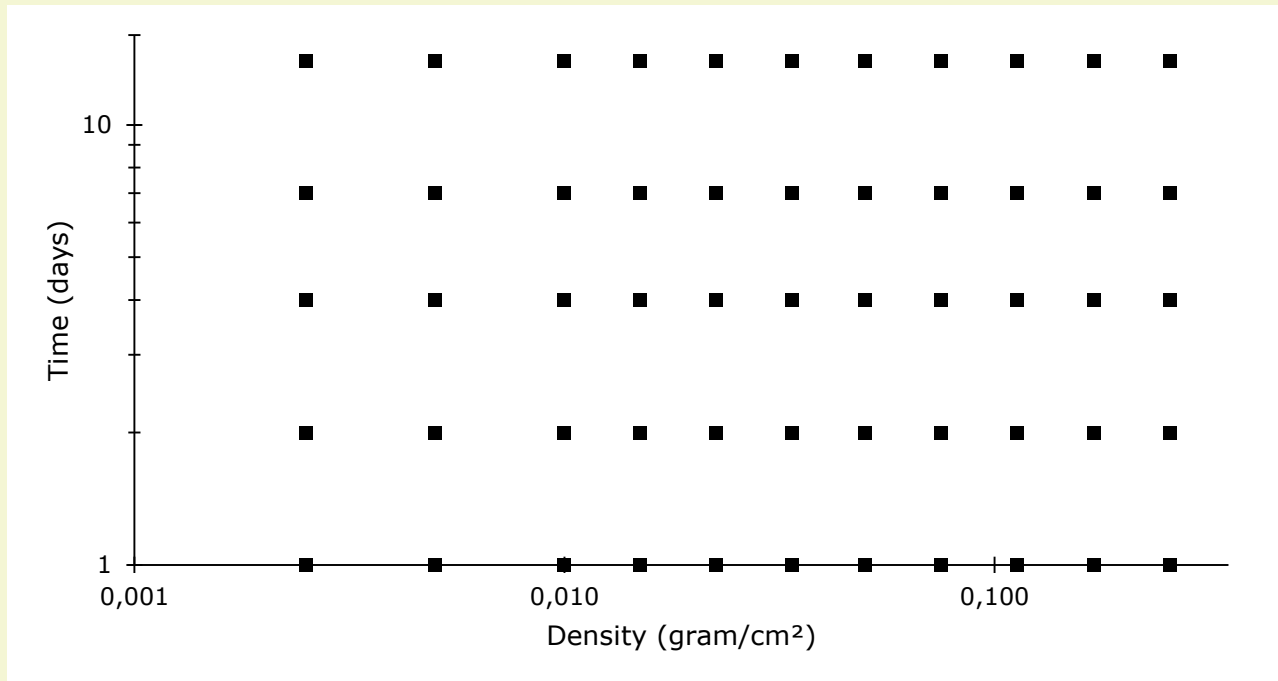
- Sex ratio
- Temperature
- Humidity
- ...

Experimental setup

Standard way of breeding on semi-industrial scale

- Wheat bran + daily moisture source (carrots)
- Oviposition in wheat bran or on the floor of the container
- # mealworms was determined after 9 weeks

Experimental setup



Model ranges

Oviposition: 1-14 days

Beetles: 0.5 – 500 gram

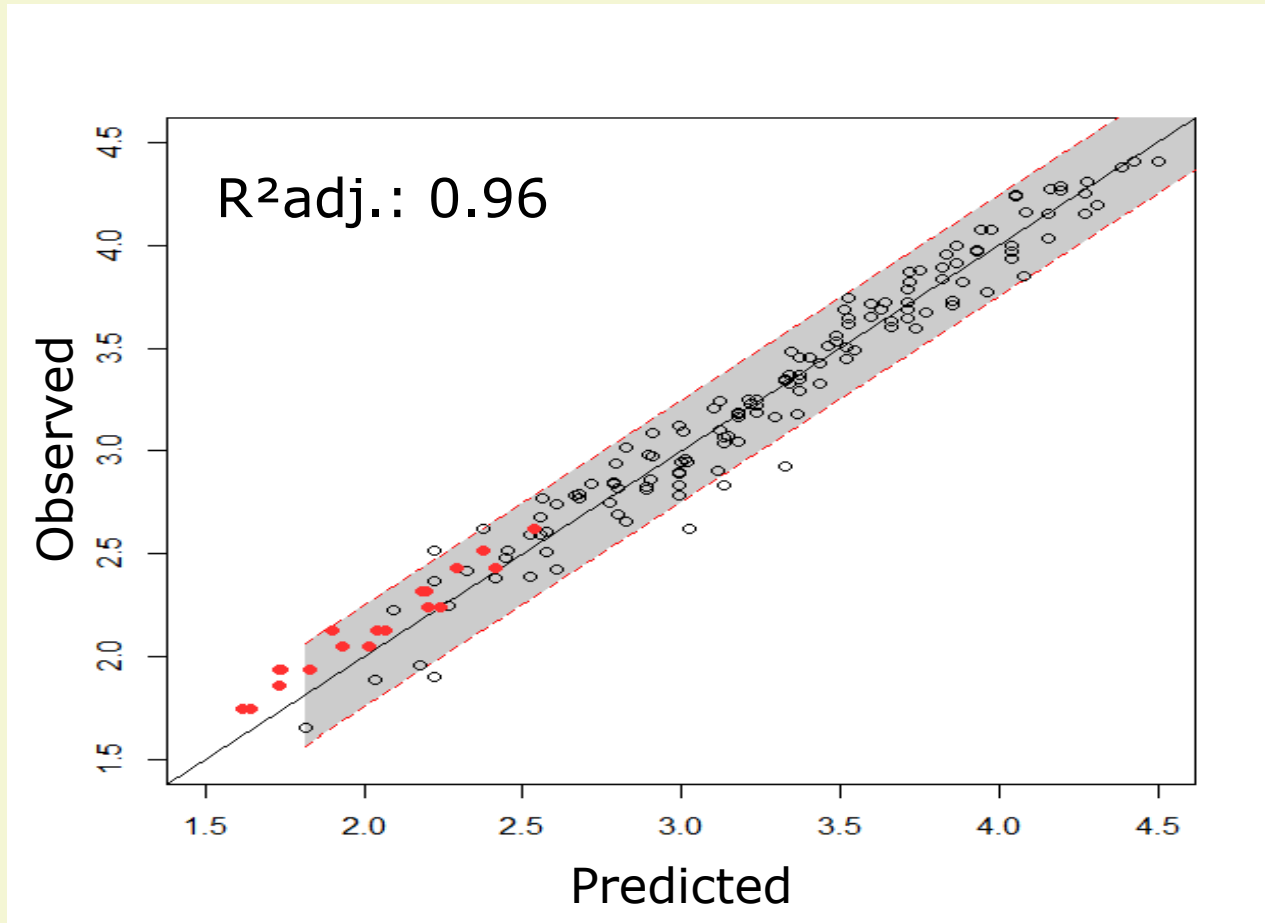
Area: ± 200 - 2150 cm²

Beetledays

=

$\text{Log}_{10} (\text{Beetles} * \text{Days})$

Beetledays: result

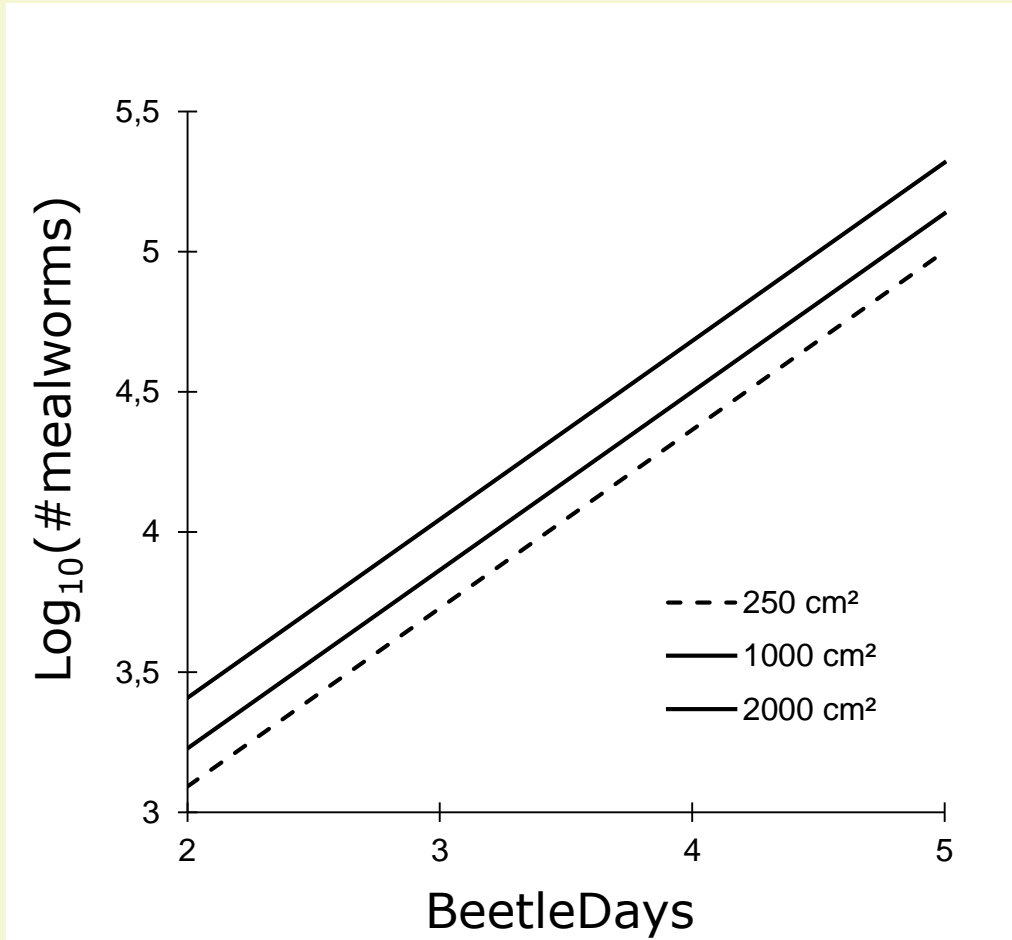


$$\text{Log}_{10}(\#MW) = 1.77 + 0.64 * BD + 1.80 * 10^{-4} * \text{area}$$

Beetledays = $\text{Log}_{10}(\text{Beetles} * \text{Days}) * \text{Log}_{10}(\text{surface})$

● Berggreen et al. 2018

Beetledays: result



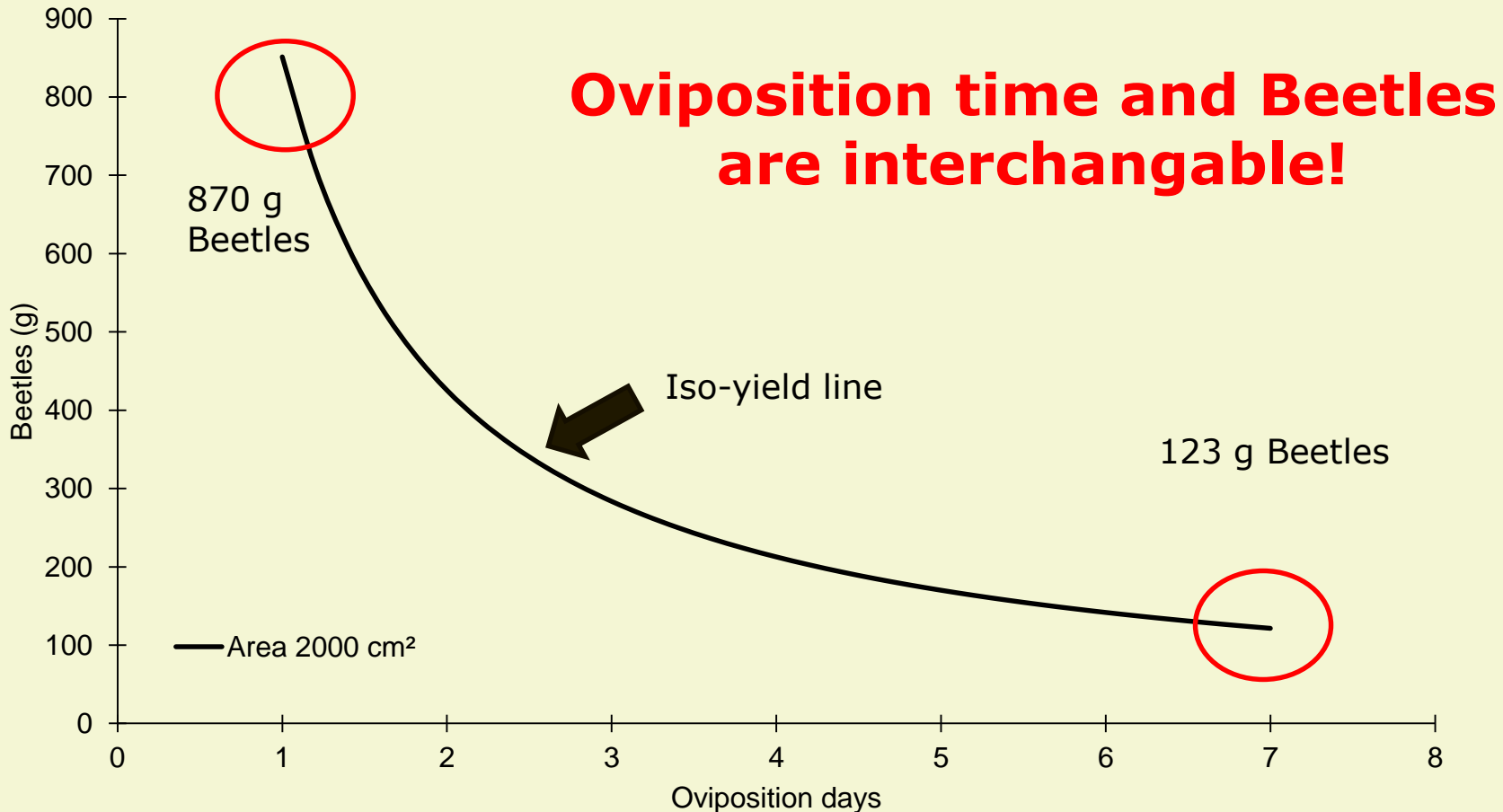
- Continuous increase in # mealworms with increasing BD
- But: decrease in *per capita* offspring
- Decrease in density increases yield

$$\text{Log}_{10}(\#MW) = 1.77 + 0.64 * \text{BD} + 1.80 * 10^{-4} * \text{area}$$

Beetledays: Example 1 kg harvest

1) Harvesting 1 kg at mw at 0.1 g at 2000cm²

2) $(\text{Log}_{10}(10000)-1.77- 0.00018*2000)/0.64 = \text{Beetledays} = 2.93$





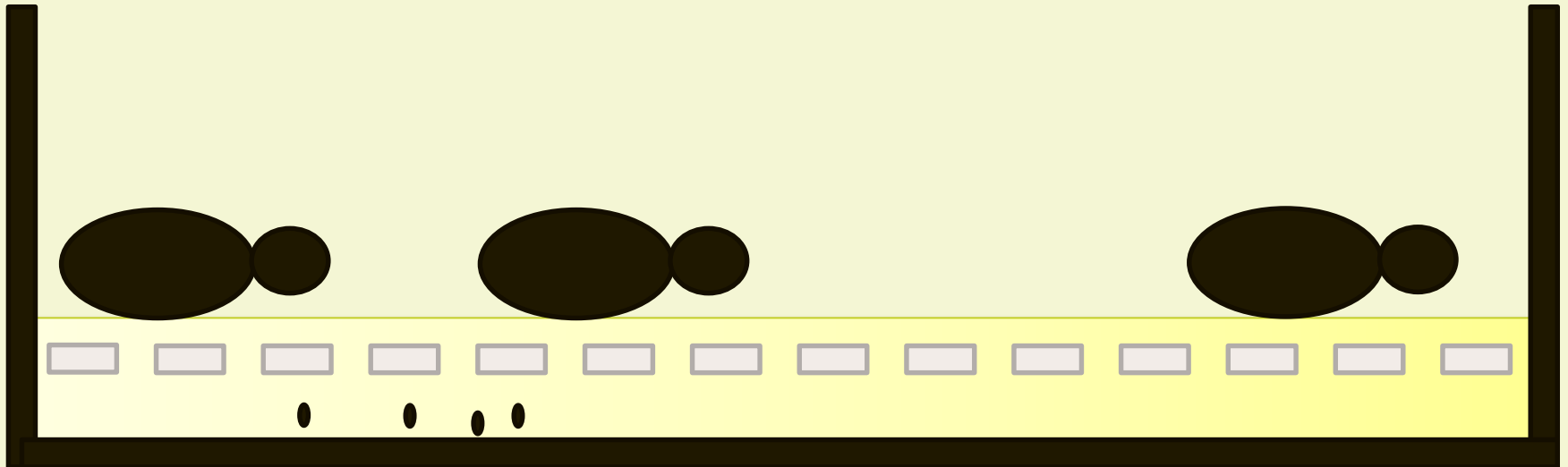
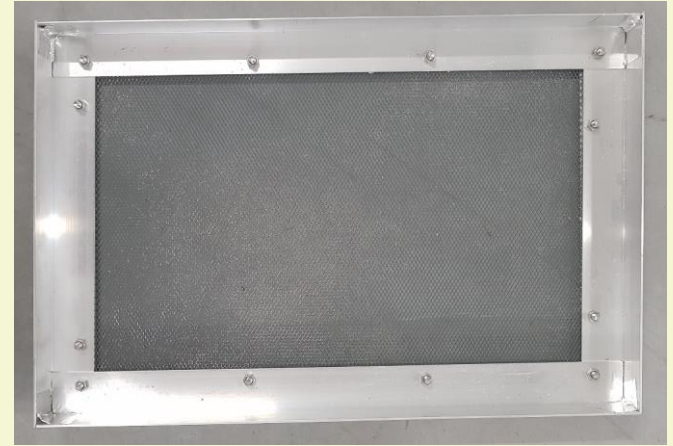
Active control

Collect eggs

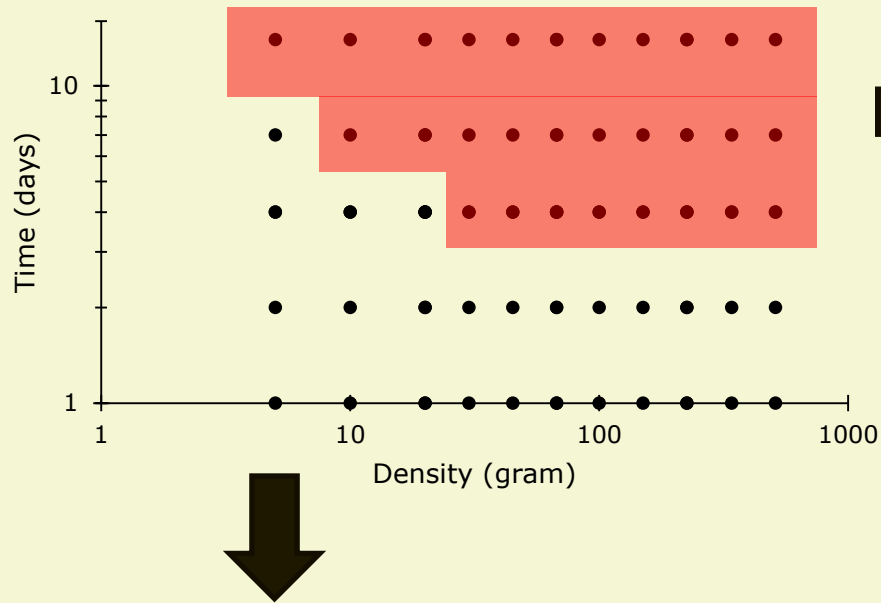
- Is it possible
- Egg weight \approx # offspring
- Reduced cannibalism

Egg separation: method

- Beetles on screen 6mm from container floor
- Beetles were forced to lay eggs in flour
- Eggs were removed by sieving at 0.5 mm



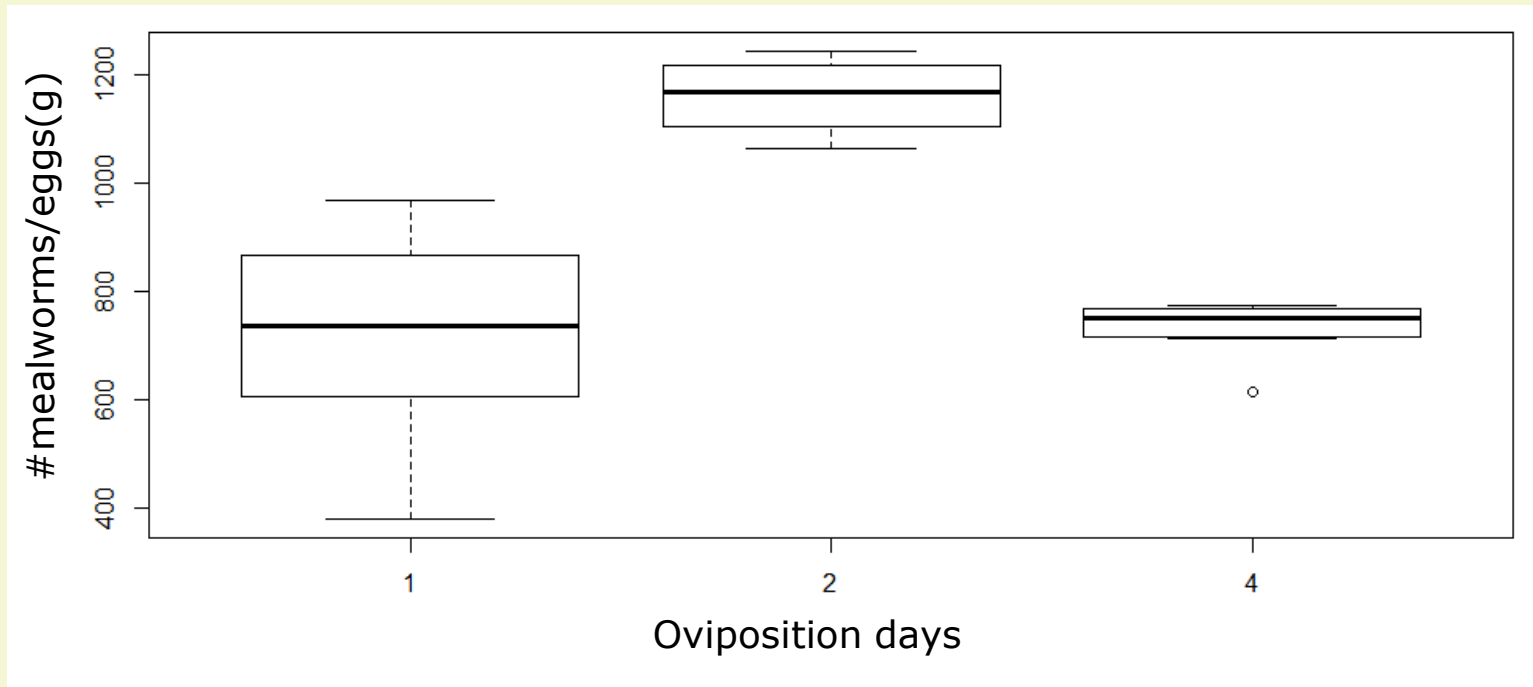
Egg separation



Possible but currently only for lower densities and/or oviposition times

Egg weight vs # mealworms

It is possible... But...



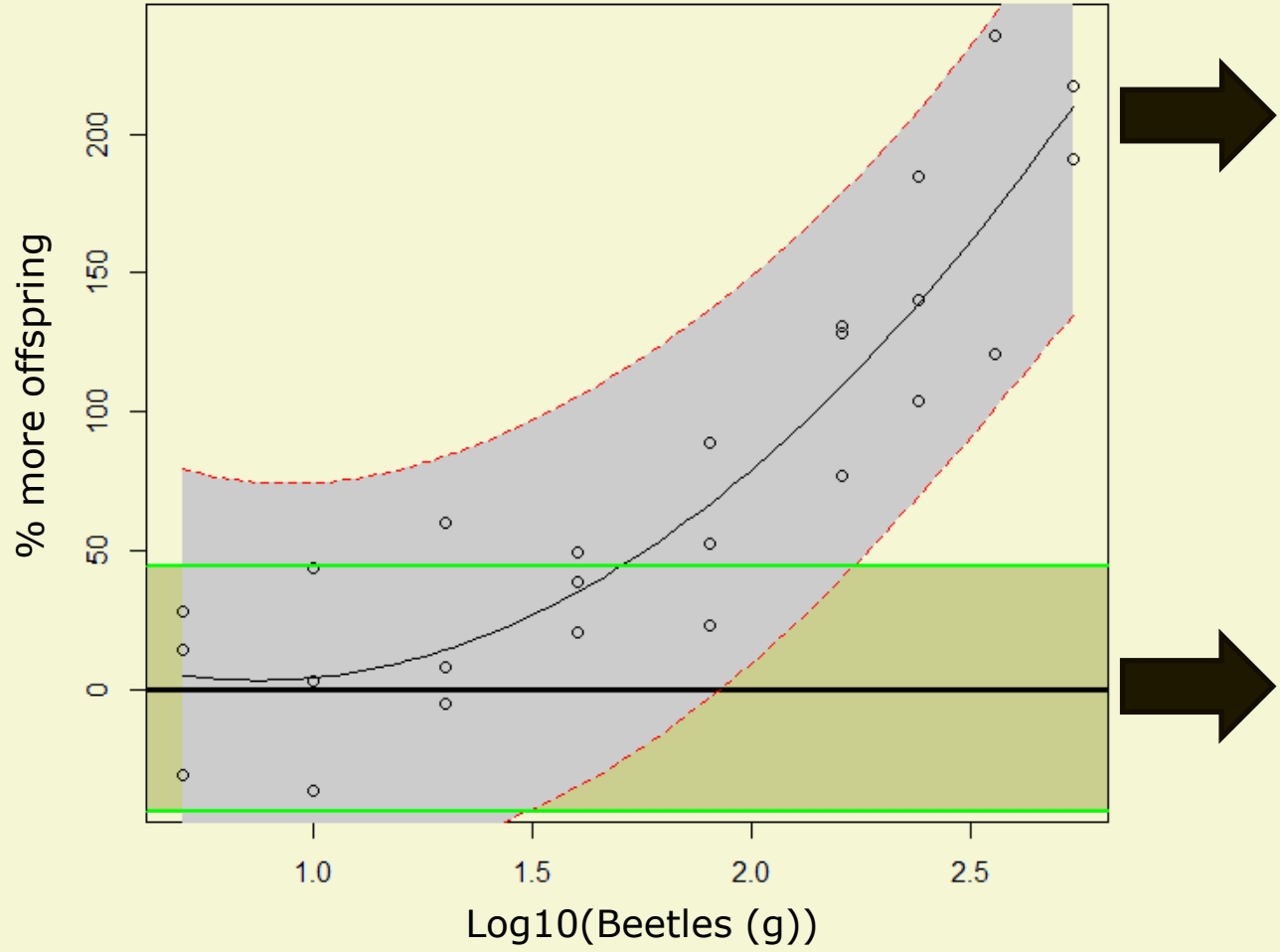
727
± 198

1160
± 66

729
± 56

Highly variable, better harvesting method is needed.

Egg separation vs cannibalism



New method


Up to 200% more offspring at high densities

Classic rearing method
(previous model)

Conclusion

- **Beetleday model:**
 - Easy to use
 - A priori decision of # MW/container
 - suboptimal production at high densities
- **Separating the eggs:**
 - Is possible and can be good,
 - A posteriori decision of # MW/container
 - Higher yield at high densities,
 - Workload increases significantly






Optimizing growth during first weeks of *Tenebrio molitor* rearing

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Discover the infrastructure 

Introduction

Efficient mealworm rearing is essential to make industrial mealworm production a viable sector. Understanding the needs of mealworm on a semi-industrial scale is therefore a key factor.

It is known that mealworm growth benefits from adding a moisture source (e.g. carrots) to their diet. However it is unknown when mealworm start to profit from the moisture source and especially how this interacts with the climate. Even professional breeders have varying opinions on this topic.

By determining the influence of moisture source timing, temperature (T), relative humidity (RH) and their interactions on early mealworm development, key insight can be attained to make rearing systems more efficient.

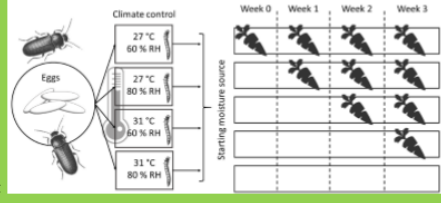
Material and methods

Tenebrio molitor on semi-industrial scale
 Production trays (60x40 cm)

7 days of oviposition

- 4 climates
- 5 feeding regimes

Hatching and growth for 4 weeks
 Daily moisture source supply ~ feeding regime and *Ad libitum* wheat bran

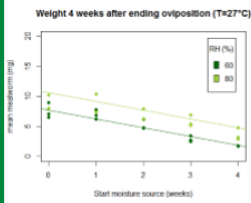


Results & Discussion

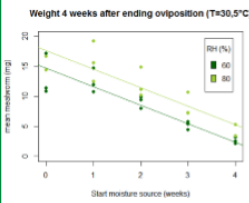
For growth:

- Higher T is positive
- Higher RH is positive
- Early acces to moisture source is positive
- Important interaction between temperature and moisture source supply

Weight 4 weeks after ending oviposition (T=27°C)



Weight 4 weeks after ending oviposition (T=30.5°C)



Despite the significance of the model, there is no significant difference between starting moisture source right after oviposition or 1 week later (based on a Tukey test). Suggesting that during the first week moisture source is less urgent.

Mean weight (mg) = 11.14 * MS + 2.00 * T + 0.14 * RH - 0.46 * T * MS - 55.34 (R² Adj. = 0,85)
MS = start moisture source (weeks) T = Temperature (°C) RH = Relative humidity (%)

Conclusion

Mealworm growth can be increased significantly by increasing temperature (up to 31 °C), relative humidity and providing a moisture source during early development. The higher the temperature, the more benefit can be achieved by early moisture source supply. Further research is needed to determine the minimal amount of moisture source required.

