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The BioConVal project: Conversion of chicken manure by fly larvae

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BioConVal (**BioCon**version to **Val**ue)

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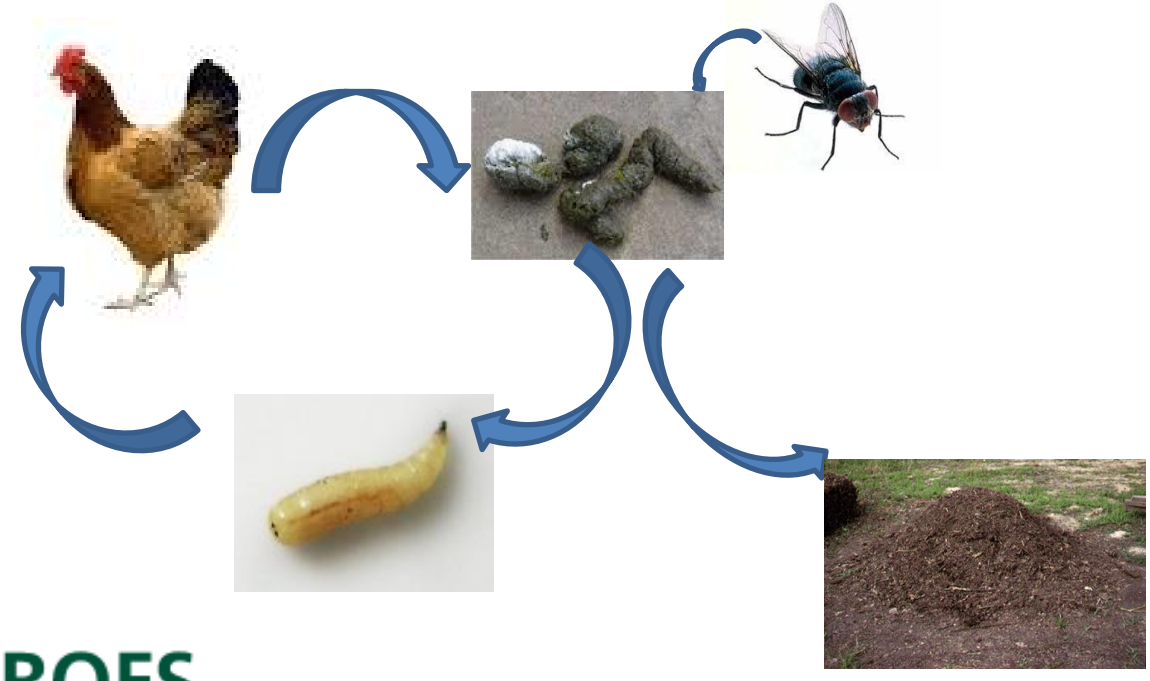
Project goals:

- Bioconversion of poultry manure by fly larvae
- Feed live larvae back to organic layer hens
- From lab scale larvae production to integrated system at the farm



ICROFS
International Centre for Research in Organic Food Systems

BioConVal (**BioCon**version to **Val**ue)

R&D project (2012-2014)

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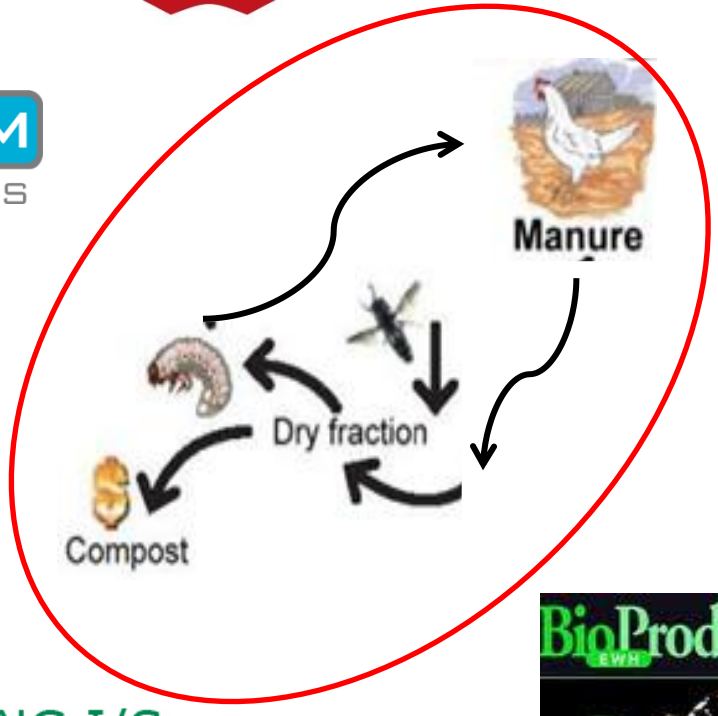
DTU

Egg producer

DORSET GM GREEN MACHINES

VIDENCENTRET FOR LANDBRUG



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Bioconval –focus topics

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- Fly larvae production
- Compost product
- Feed safety (pathogens)
- Feed and infection trial (gut flora, welfare)
- Feed trial at farm level (production parameters, animal welfare)








BioConVal – 'practical ambition'

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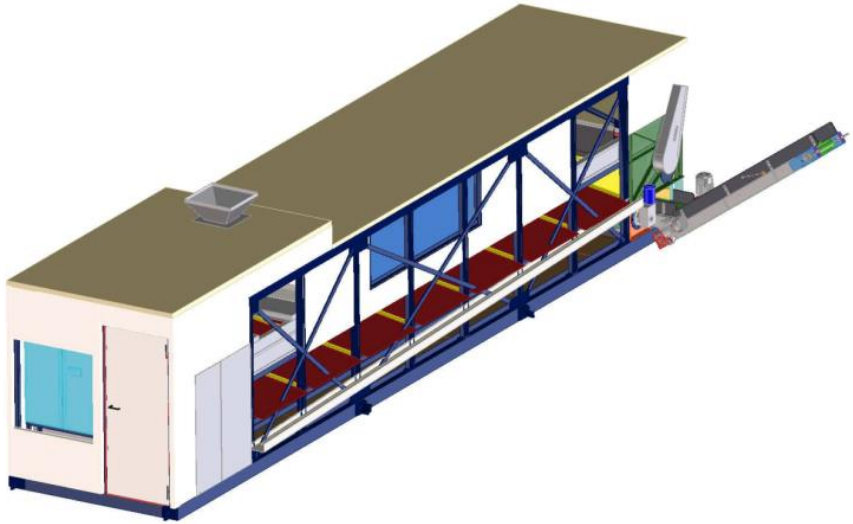
- Ambition: To develop a semi-automatic on-farm larvae production system for bioconversion of chicken manure

Lab scale



Full scale on farm

Practical factors of importance…

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- Fly breeding
- Storage of fly eggs
- Larvae rearing
- Separation of larvae from manure
- Economic assessment

Musca fly breeding and egg production

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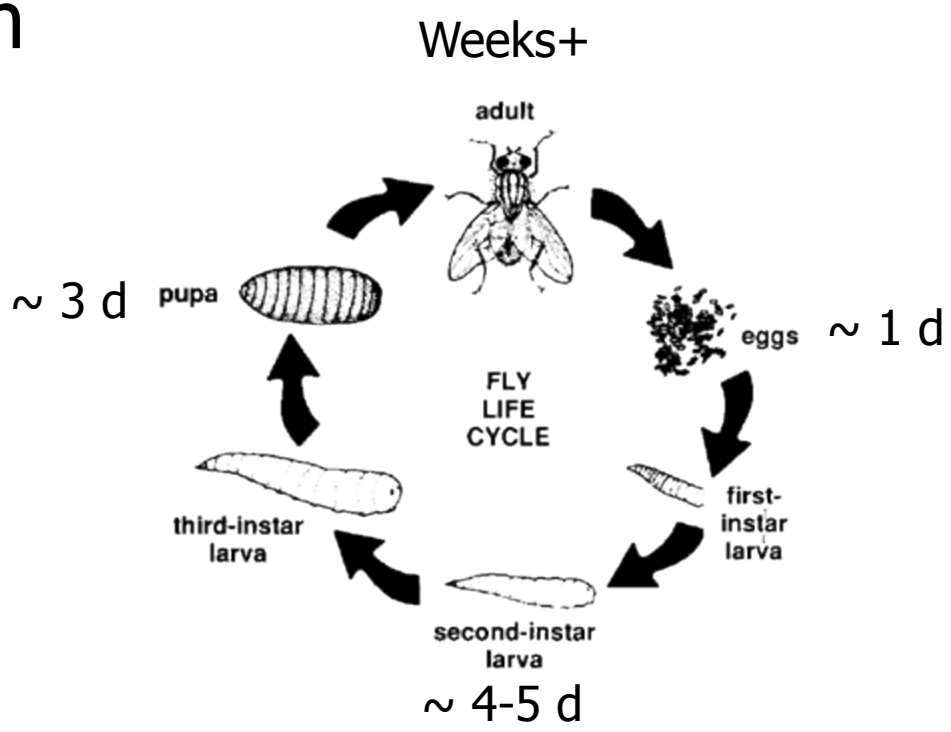

- Egg collection

- Development of 'manure-ball'
  - Different designs and types of textiles
  - Possibility to quantify eggs (reducing variability - improving yield)

Storage of *Musca* fly egg

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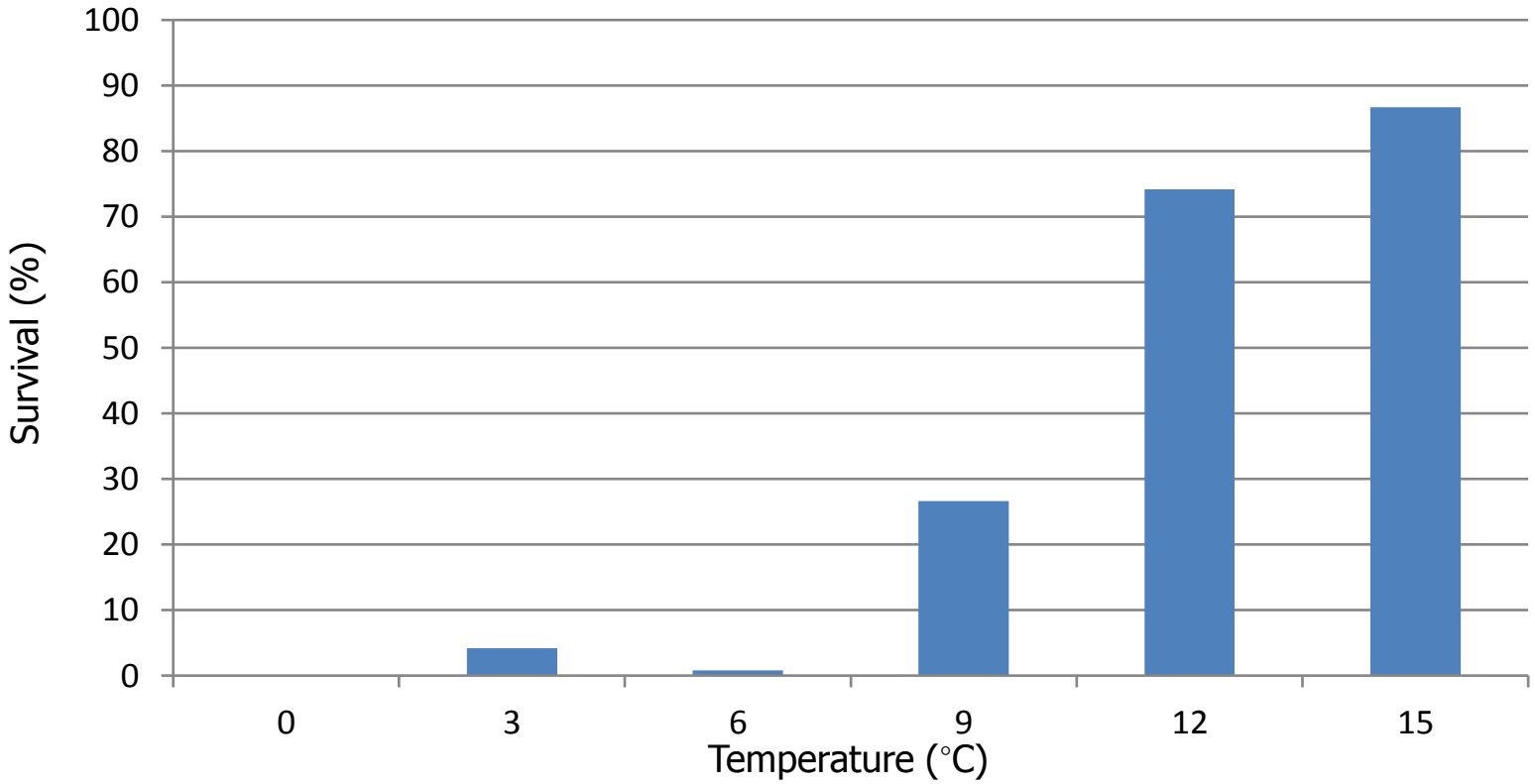
Hatchability at 25°C following 72 hr storage at different temperatures



(*H. Skovgaard, AU*)

Musca larvae rearing in manure

- Factors influencing feed conversion rate

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Process: Manure and water — Larvae rearing — Harvest larvae — Compost

- Pre-treatment of manure (fresh manure favourable)
  - Homogenisation and addition of water (dry matter 25-30%)
- Application/dosage of fly egg
  - Egg density (~10,000 eggs/kg manure)
- 'Stirring' of manure
- Maintaining environmental conditions

Larvae production

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Poultry manure: 80 kg

+

Fly eggs: 1 mio (100 mL)

+

Water: 20 L

3-4 days
@ 25-40 °C

Theoretic outcome:
10 gram larvae pr. hen pr. day

Compost: 50 kg

+

Larvae: 8 kg


0 01:15:10

Separation of larvae from manure - Assessment of various methods

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- **Flotation** (high water demand, wet compost product)
- **Sieving/screening** (not suitable for heterogeneous substrates)
- **Light** (only suitable for 'thin layered' substrates)
- **Electricity** (energy demanding and difficult to apply)
- **Hermetic enclosure** (low cost, may be difficult to apply)
- **Heat** (energy demanding, very efficient separation)



Separating larvae from manure (Hermetic enclosure)

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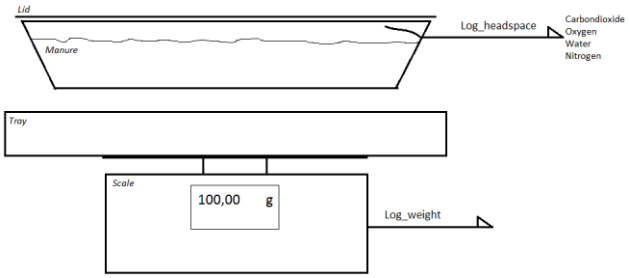
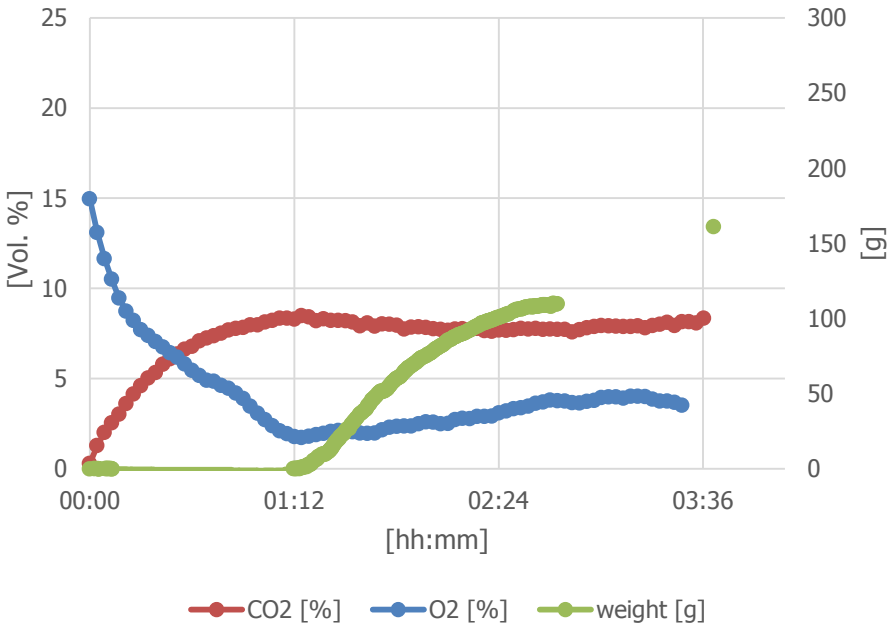
- Confined space: lid placed on box (day four)
  - Airflow controlled by elevating/lowering the lid
  - Oxygen ↓ and CO2 ↑
- Low energy method!
- Recovery 70-95%
- Not suitable for the present container design + scalability ?





Separating manure and larvae - Heat

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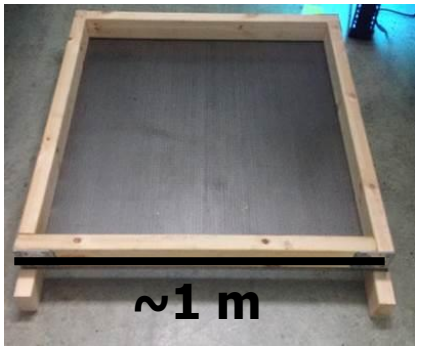
- Direct heat used for separation (heated metal lid, PID controller)
- Initiation of separation @ 50°C
- Energy consuming (estimate of 2 kWh/kg larvae)
- Scalable (Recovery 90+%, ~100% @ small scale)



- This was chosen as the way to go at the farm trial!

Fly egg vs. Larvae production

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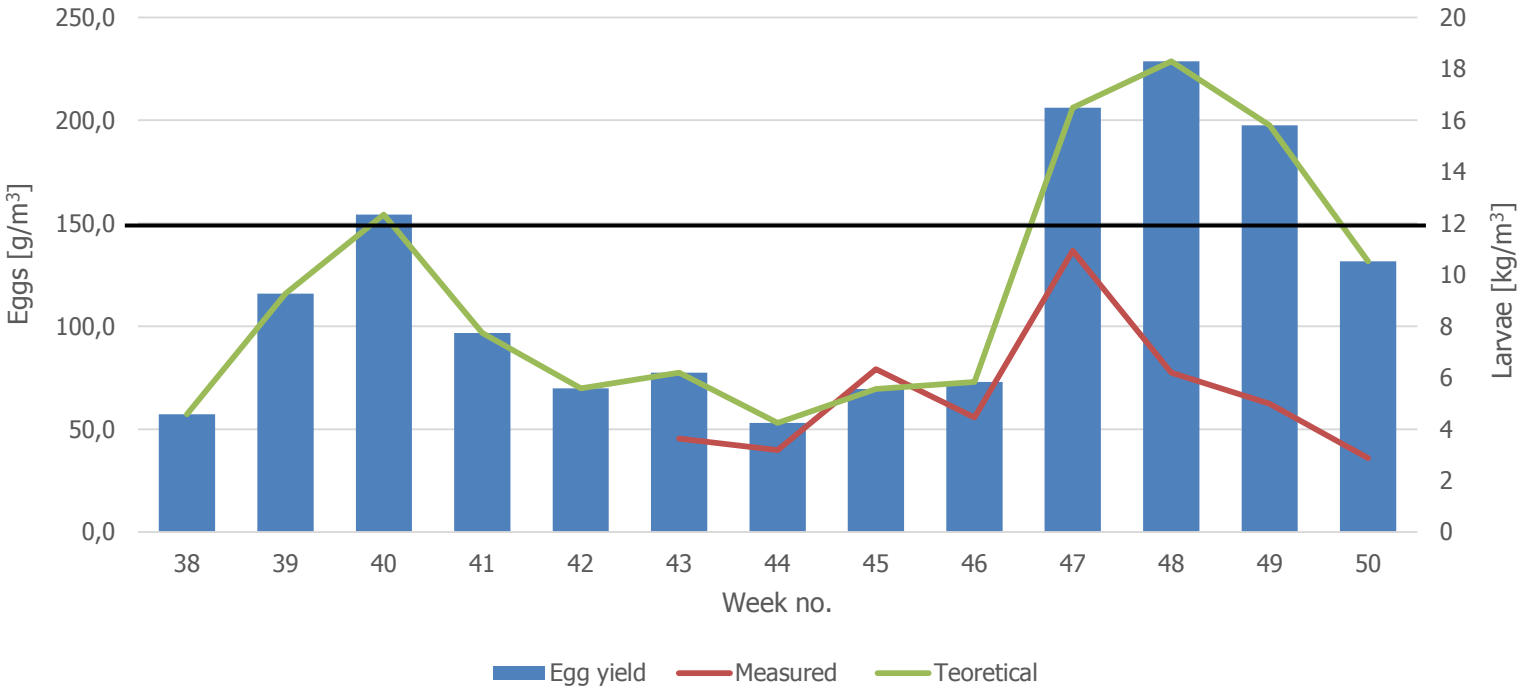

Egg yield$_{ave}$: 150 g/m^3 fly breeding area

-> produce 12 kg larvae/m^3 fly breeding area

-> we need 12 m^3 fly breeding area (~140 kg larvae) for sustaining the container system

Compost from larvae bioconversion

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- Fertilizer value comparable to conventional compost
  - Suitable as a fertilizer product!

	Nitrogen (% DM)	Phosphate (% DM)	Potassium (% DM)
Conventional	2	1	2
Bio-converted	2,5	0,8	1,6

What does it take to make it fly?

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- Increasing larvae meal prize
  - Ban of fish meal for organic egg layers?
- Improving the container system
  - Lower production price of container unit
  - Optimizing automation/processing
- Improving rearing and breeding of *Musca*
  - Improving egg survival (application of eggs)
    - Shipment conditions of fly eggs

Conclusions from Bioconval

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- Bioconversion of manure using insects has great potential, particularly in organic farming where essential amino acids are difficult to obtain
- Project generated knowledge on the cultivation of fly larvae as a sustainable source for essential amino acids
- Fly larvae = protein source with ideal amino acid composition
  - Opens up for 100 % Organic feed in egg production
- Feeding live larvae had a positive effect on animal welfare
- Feed safety was addressed (you will hear more later today)
  - Necessary, for future legislative changes..

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Thank you for your attention!