# Investigating an invisible enemy: the problem of ammonia in insect farming

Boatta, F; Brouzes, C; Dignan, A; Lucas, J; Oubrier, I; Deruytter, D; Coudron, C

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Agronutris
Raise and rise together

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ONDERZOEK & ADVIES IN LAND- & TUINBOUW

# Context

- Ammonia is an harmful gas that can be present in insect facilities as result of farming activities
- We know that this chemical can be harmful for operators but little is know about its effect on larvae

# Aims

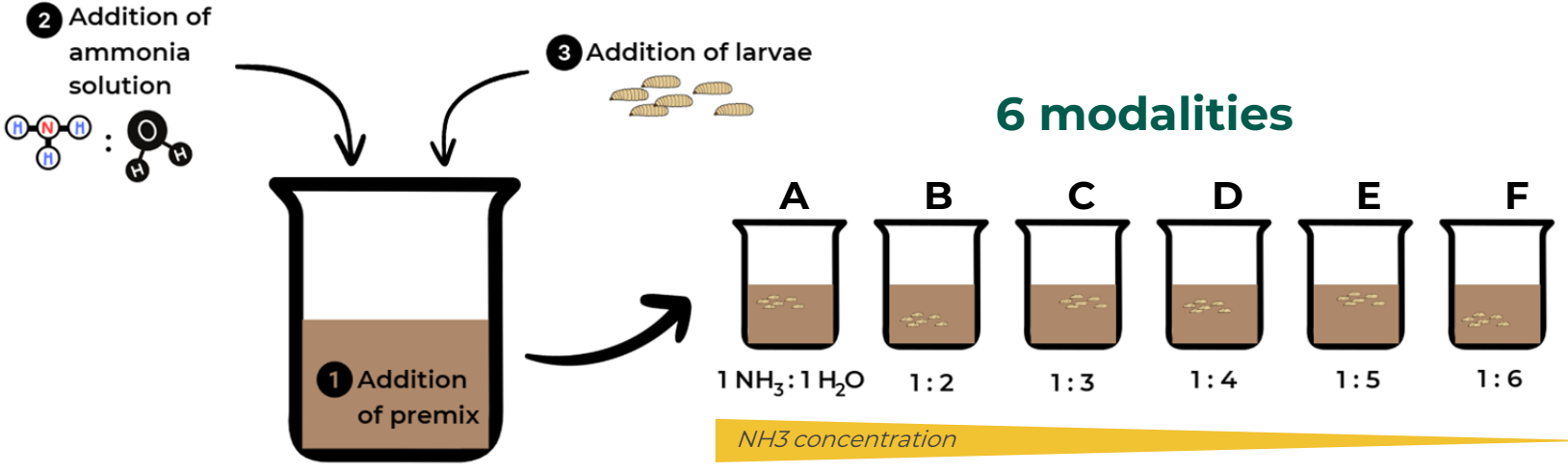
- Given the **potential production of ammonia during larval growth**, it is important to **assess their tolerance to NH3** (concentration and duration of exposure)

- The aim of this test was to explore the harmfulness of ammonia **liquid and gaseous ammonia** to the larvae

# Experimental design liquid ammonia

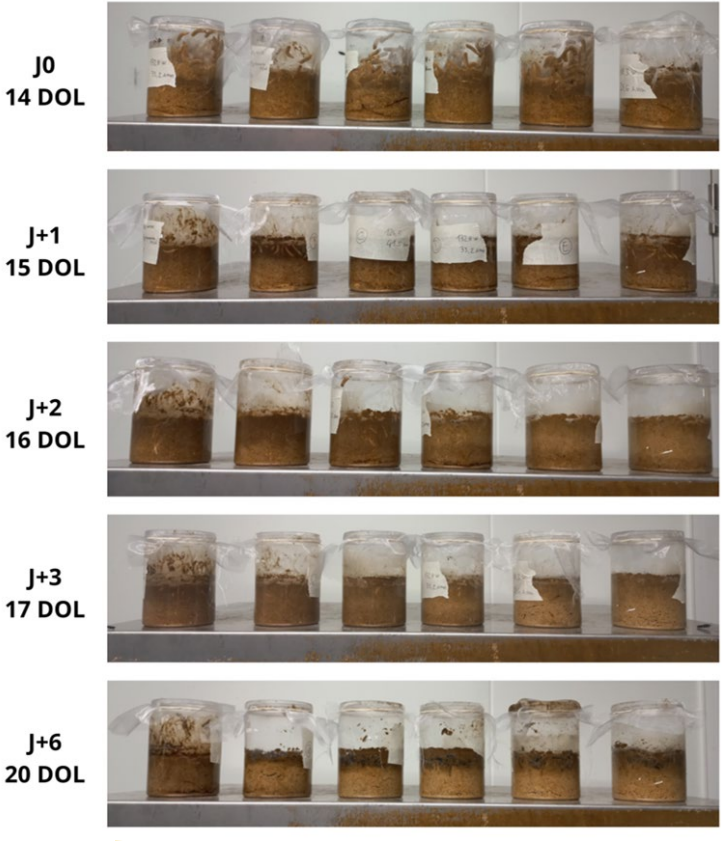
- Production of substrates with additiona of ammonia
- Let them grow for a few days (from 14 to 20 DOL)
- Every day :
  - The **behaviour of the larvae** is observed, and the **number and appearance of dead larva**e are noted
  - The **pH** and **T°** of the substrate is measured
- At the end of the trial, all the pots are counted and the **survival rate** and **prepupes rate** are calculated

# Experimental design liquid ammonia




- NH3 solution 13% v/v
- 88 g CF + 88 g solution (H20 + NH3) ⇒ ~30%DM mix
- 306 larvae/pot (14 DOL, hand counted)

# First results




- At the start of the test :
  - Many **crawl-off attempts** especially in substances with high NH3 concentrations
  - Substance produced by larvae in quantities proportional to NH3 concentration (**bubbles**)

Agronutris
Raise and rise together

# First results

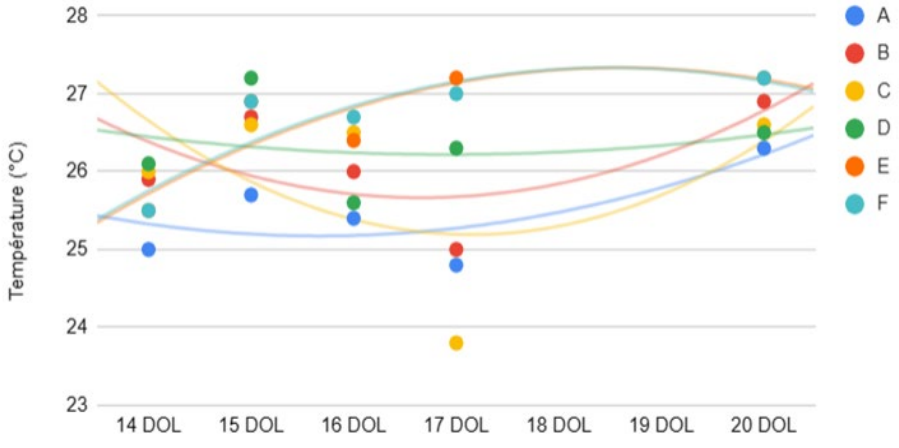
- Over the following days :
  - **Crawl-off attempts** have stopped
  - Diminution of the **larvae activity**
  - Increasing presence of **dead larvae** on the surface (mortality peak at D+3 ⇒ 17 DOL)

according to a gradient that follows the NH3 concentration of the substrate

# First results

- Over the following days :

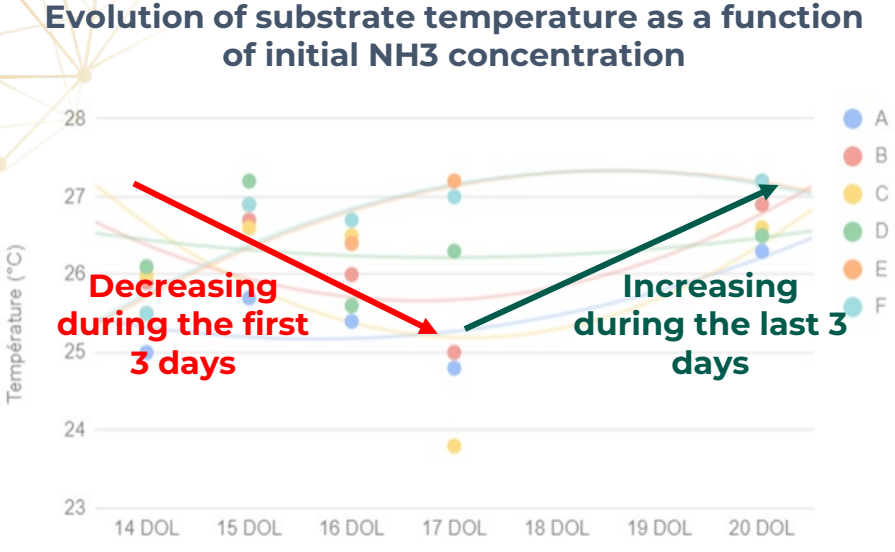
**Evolution of substrate temperature as a function of initial NH3 concentration**




| | NH3 | H2O |
|---|---|---|
| A | 1 | 1 |
| B | 1 | 2 |
| C | 1 | 3 |
| D | 1 | 4 |
| E | 1 | 5 |
| F | 1 | 6 |

# First results

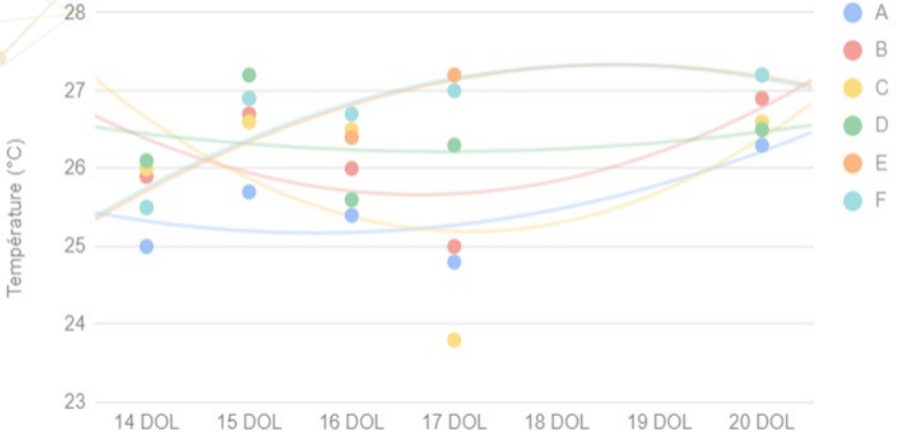
- Over the following days :



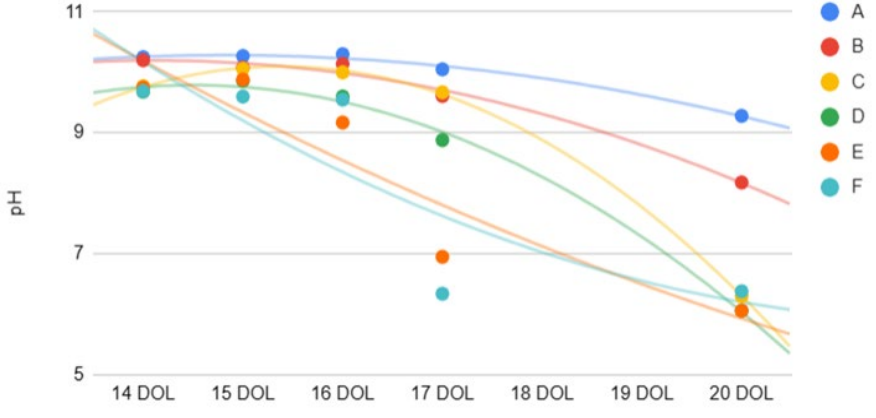
# First results

- Over the following days :

**Evolution of substrate temperature as a function of initial NH3 concentration**

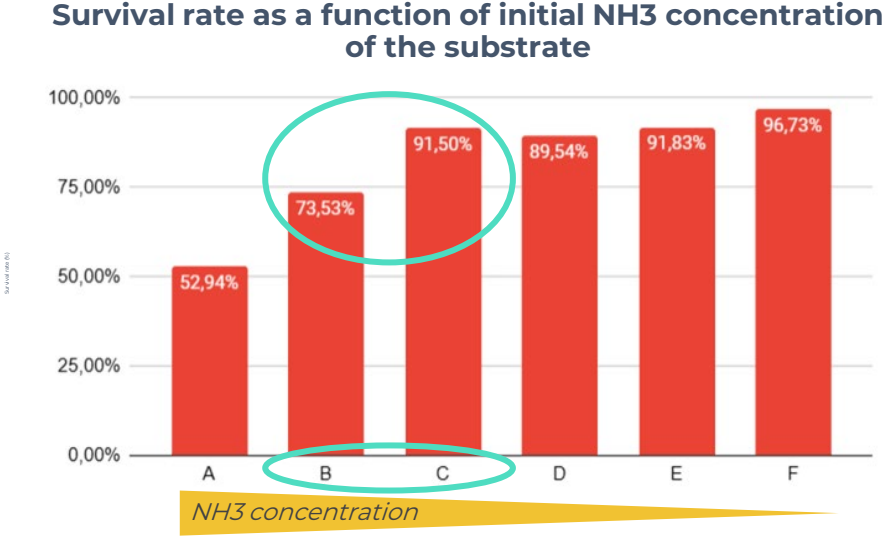



**Evolution of substrate pH as a function of initial NH3 concentration**



# First results

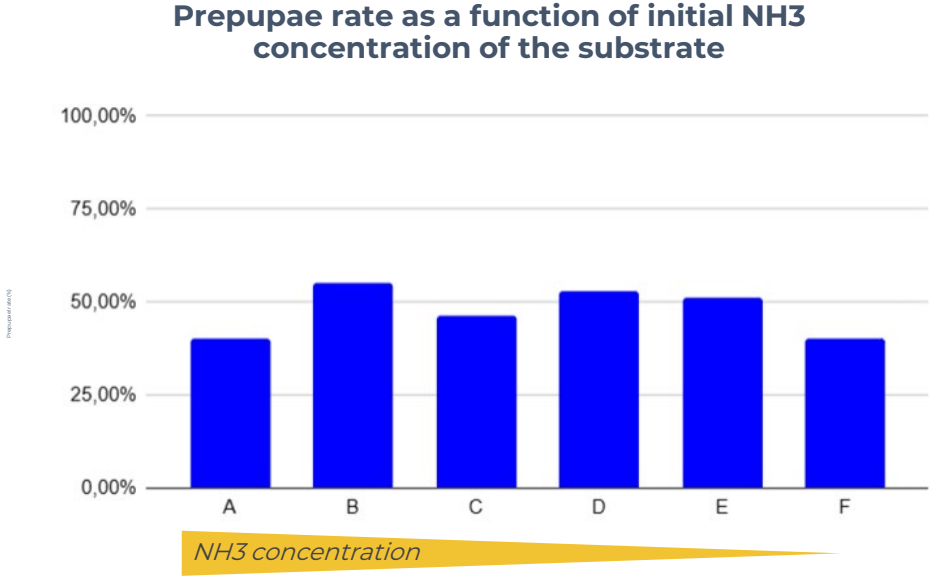
- After 6 days (at 20 DOL) :
  - **Survival rate** seems to be **negatively affected by ammonia**




Dead larvae from modality A

# First results

- After 6 days (at 20 DOL) :
  - The prepupal rate does not seem to be affected by ammonia



# In a nutshell...

- **Survival rate appears to decrease with increasing NH3 concentration**
- Survival rate seems to be affected when NH3 concentration exceeds that of modality C (A -50%- and B-33%-)
- Mortality peaks after 3 days
- Temperature drops until peak mortality, then rises until end of experiment
- Gradual pH decrease over the course of the experiment, regardless of pH and initial concentration (in NH3)

# Gaseous ammonia

- Tested the effect of acute exposure of gaseous ammonia at small scale
- 100% of mortality with 13% concentrated liquid ammonia let to evaporate is a small chamber
- Collaboration with **Inagro** to utilize the accumulation chamber to obtain precise values
- Discovered that the tolerance of the larvae is very high and that goes beyond the detection ability of sensors

# What's next?

- Chronic exposure to ammonia might help identify potential effects of this chemical on growth rate and other important KPIs
- A flow-trough chamber is being developed at Inagro and we really look forward to continue our collaboration to investigate this invisible enemy

# Thanks for your attention !