

# GCIRC Technical meeting

Towards a new method for managing  
nitrogen fertilisation in winter rapeseed

10th April 2025    Emile LEREBOUR

# Plan

## 1. Context of nitrogen fertilisation management in France

## 2. Dynamic nitrogen fertilisation: the case of the Appi-N wheat method

- Main principles behind dynamic nitrogen fertilisation management
- Implementation of the Appi-N method in the field
- Main results obtained using the Appi-N method

## 3. Designing the future method for dynamic nitrogen fertilisation of rapeseed

- Approach used
- Limits and risks of current nitrogen fertilisation methods and practices
- Creation of knowledge applied to rapeseed
- Participatory design workshop

## 4. Follow-up and outlooks

# Context of french fertilisation management

French balance sheet method: adapting nitrogen supplies to crop needs.

At the end of winter, estimate:



Total N needs of the crop =

Yield target (t/ha) \* N needs per tonnes of grain  
- N already absorbed by the plant

Total N furnitures =

Soil N supplies (mineral N in the soil and N mineralisation)  
+ Extern N supplies (N from synthetic and organic fertilisers)

Strong scientific basis, well known by stakeholders, continually improved since 1969...

**BUT**

Not very effective in reducing nitrogen losses in the field (air and water pollution).

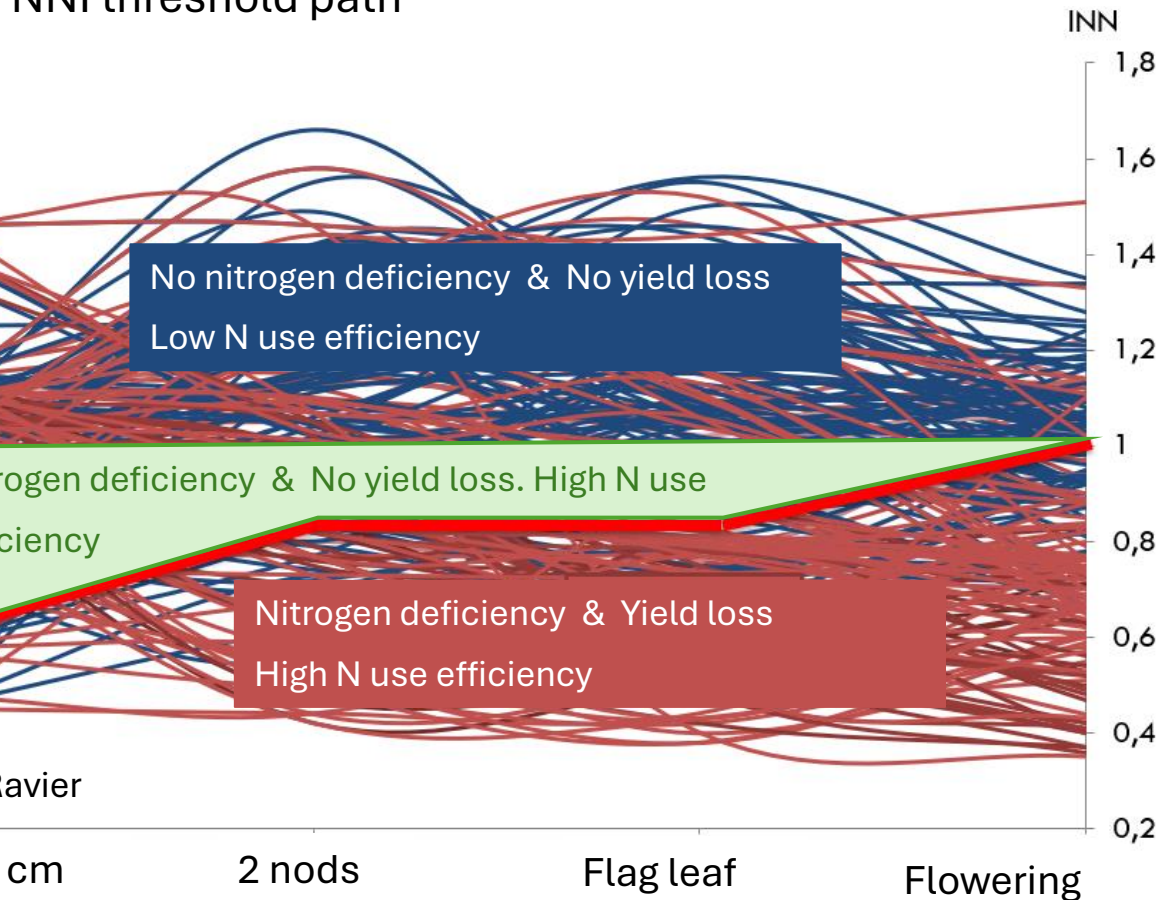
- Problems of use (yield target and mineral N in the soil at the end of winter)
- Predictive and static

⇒ "Appi-N" wheat method (*C. Ravier thesis, 2017*)

# Main principles behind dynamic nitrogen fertilisation management

⇒ **Appi-N wheat method (C. Ravier thesis, 2017)**

NNI threshold path



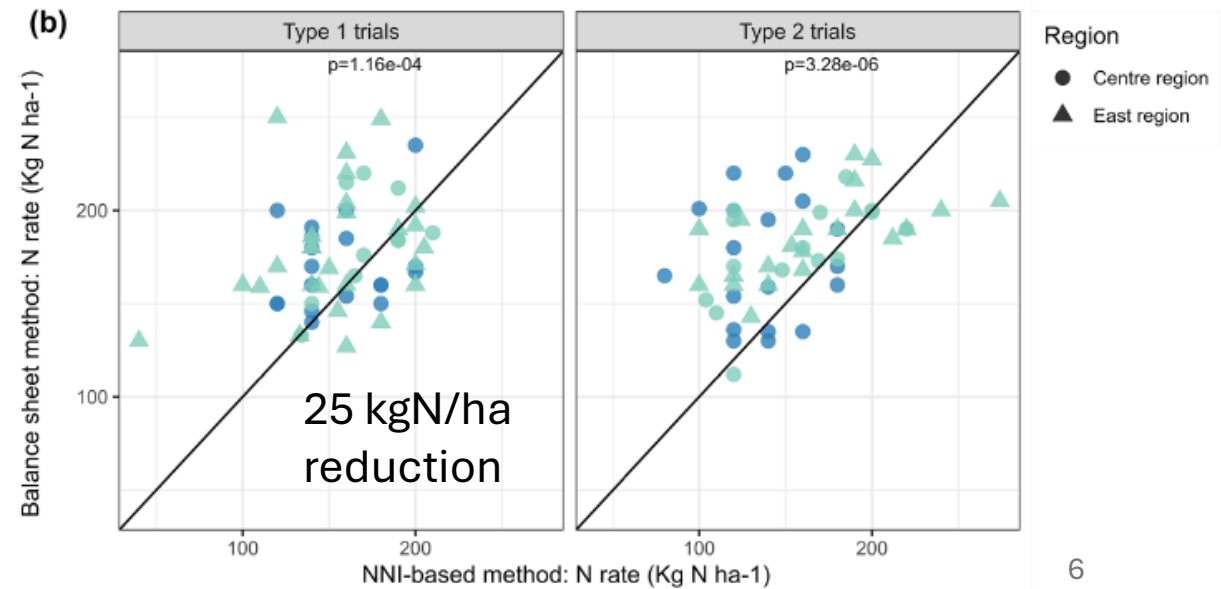
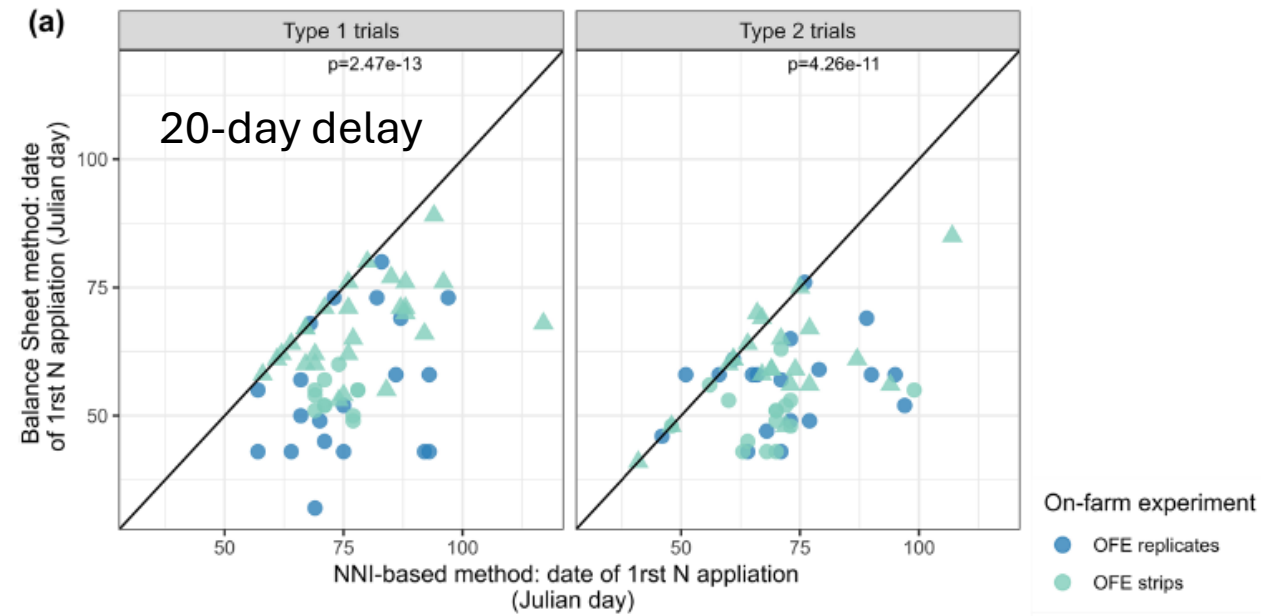
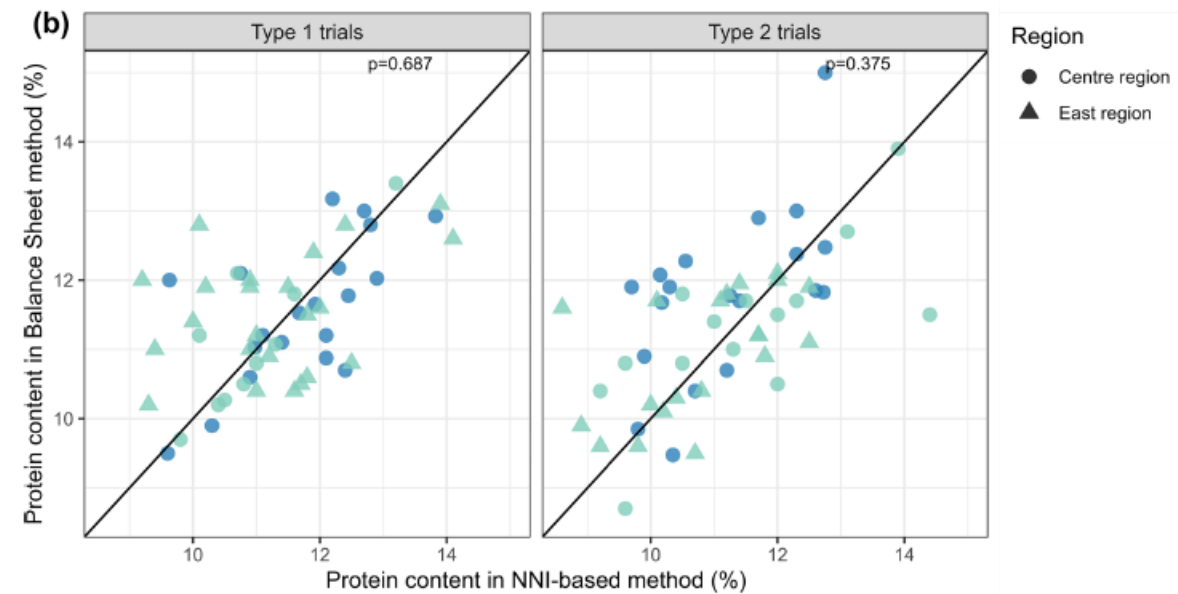
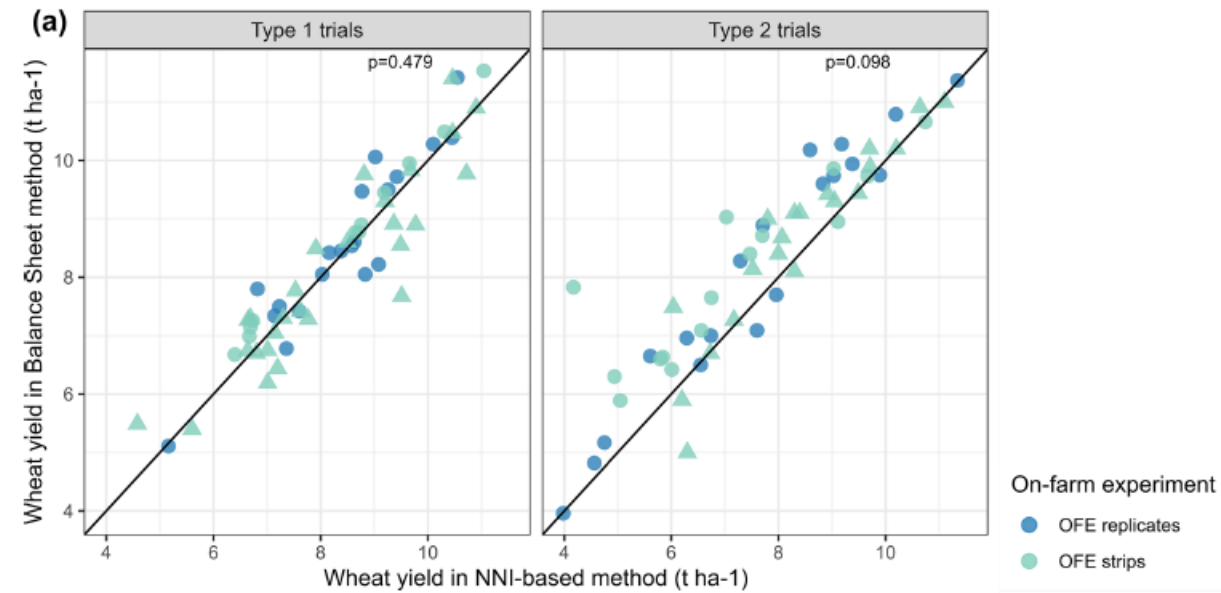
In field estimation of NNI



Nitrogen recommendation according to NNI  
(based on modelling with Azodyn-wheat)

| 6 | Période →   | 15 - 28/29 Fev | 1er - 14 mars | 15 - 31 mars | 1er - 14 avril | 15 - 30 avril | 1er Mai - sortie 1eres antheres |
|---|-------------|----------------|---------------|--------------|----------------|---------------|---------------------------------|
|   | INN ↘       |                |               |              |                |               |                                 |
|   | 0.4 à 0.5   | 0              | 60            | 60           | 100            | 100           | 0                               |
|   | 0.5 à 0.6   | 0              | 60            | 60           | 100            | 100           | 0                               |
|   | 0.6 à 0.7   | 0              | 40            | 60           | 100            | 100           | 0                               |
|   | 0.7 à 0.8   | 0              | 0             | 40           | 60             | 100           | 80                              |
|   | 0.8 à 0.9   | 0              | 0             | 40           | 40             | 80            | 60                              |
|   | 0.9 à 1.0   | 0              | 0             | 0            | 40             | 40            | 0                               |
|   | 1.0 à 1.1   | 0              | 0             | 0            | 0              | 0             | 0                               |
|   | >=1.1 à 1.2 | 0              | 0             | 0            | 0              | 0             | 0                               |

# Main results obtained using the Appi-N method



# Approach used to design the future method for dynamic nitrogen fertilisation of rapeseed

- **Interviews** with advisers + Results of the 2024 national survey on farming practices.  
⇒ Identify problems and risks in actual rapeseed nitrogen fertilisation methods and practices, to take them into account for the future method.
- **Knowledge creation** linked with dynamic nitrogen fertilisation, adapted to rapeseed :
  - Nitrogen nutrition threshold path (nitrogen deficiency zone not detrimental to yield).
  - In field estimation method of nitrogen nutrition.
- Real-time **fertilisation advice, depending on nitrogen nutrition** of rapeseed between end of winter and flowering.  
⇒ ~~Simulations using Azodyn-rapeseed~~ Data analysis of Terres Inovia's field trials.
- Setting up of **design workshops** with advisers, engineers and researchers.  
⇒ Creation of a prototype of the future dynamic nitrogen fertilisation method.

# Limits and risks of current nitrogen fertilisation methods and practices

## Farmers common methods and practices:

- N amount split in 2 or 3 applications.
- Usually between 15th February and 31st March (shorter and earlier than for wheat).
- Frequent nitrogen application in autumn (mineral and/or organic).
  
- Lots of farmers apply **a standard dose** (150-200 kg N/ha) each year.
- Some of them **adjust** it slightly depending on the rapeseed weigh after winter (with a visual estimation, the mean value given by their adviser, or by weighing it themselves).
- For farmers that **calculate** the dose with the balance sheet method, most of them **doesn't respect the recommendation** (except if it is very close to their standard dose), for several reasons, mainly:  
fear of loosing yield, habits and lack of time.

=> Frequent over fertilisation comparing to the recommendation of the balance sheet method.

**Challenge of transmitting knowledge and making the recommendation understandable.**

# Creation of knowledge: nitrogen nutrition status estimation method

Different methods considered:

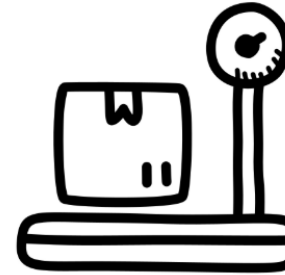
Chlorophyll meter



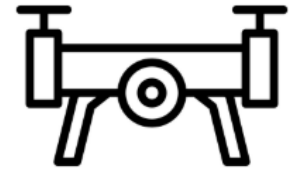
Smartphone pictures



Fresh weigh



Multispectral sensor  
(Drone or satellite)



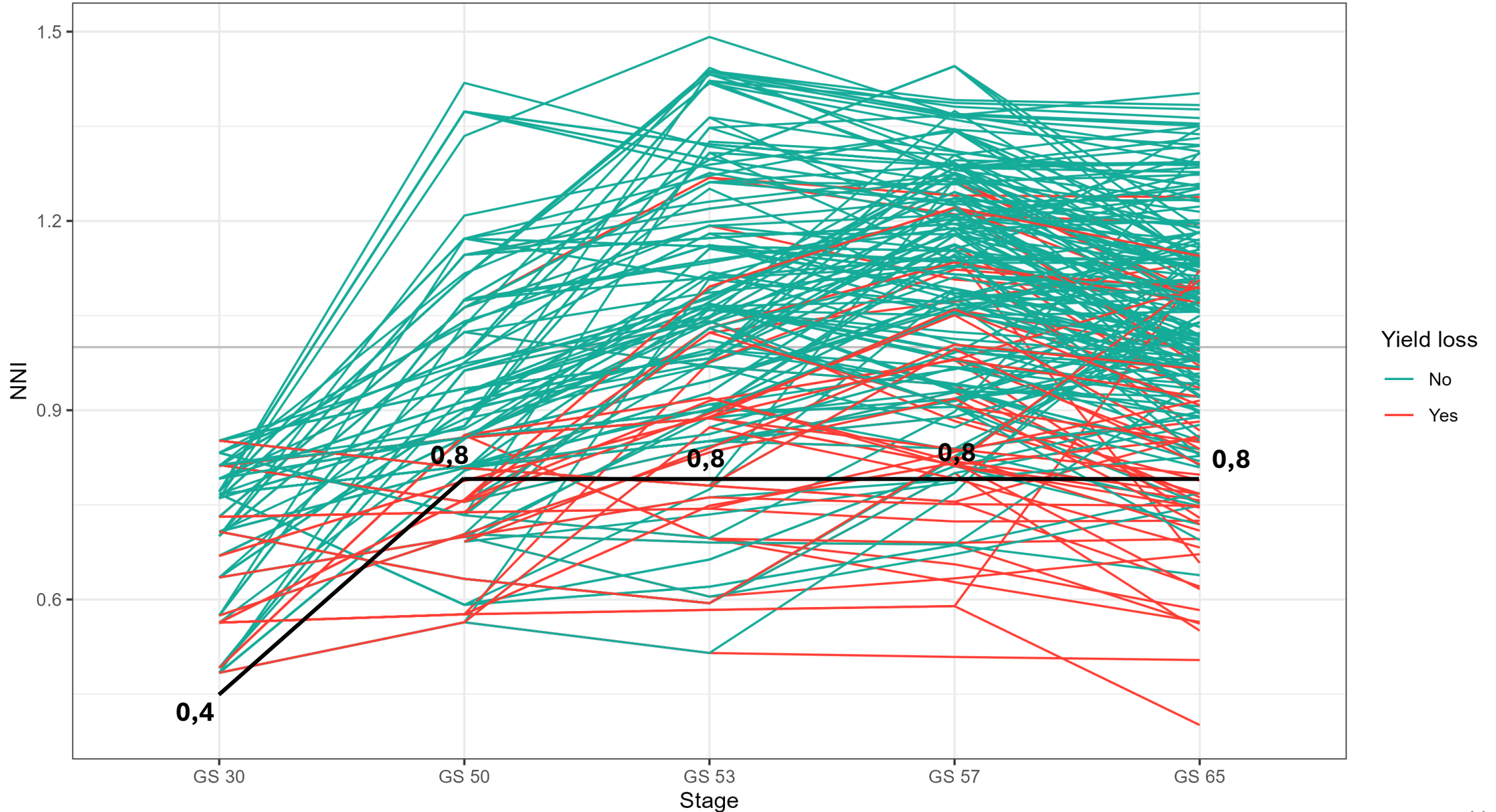
Reliability, simplicity, accessibility, time consumption...

# NNI paths depending on whether they led to yield loss or not

According to Tukey test at 5 %

In black the most likely current threshold NNI path.

(Work in progress)



# Participatory design workshop

4 engineers, 2 researchers, 1 advisor

Morning:

Knowledge sharing

- Main principles behind dynamic nitrogen fertilisation
- Method for estimating NNI in the field
- Impact of nitrogen deficiency on rapeseed yield (minimum NNI path)
- Limits and risks of actual nitrogen fertilisation practices and methods on rapeseed



Afternoon:

Reflection on the future method

- Reflection on main objectives and features of the future method (reliability, simplicity, accessibility)
- Reflection on how the future method will work (estimation method, adaptability...)
- Pedagogical aspect of the future method (knowledge transfer, ergonomics)
- Specific situations (hydromorphy, drought, reduced tillage...)

➤ Second participatory design workshop planned on September. Define a prototype of the method by then to evaluate it with various stakeholders.

# Follow-up and outlook

- **Finalisation** of in field **nitrogen nutrition estimation method** (trials in 2025) and of the minimum **NNI path**.
- Work on **real-time fertilisation recommendations** depending on the nitrogen nutrition status of rapeseed.
- **Second design workshop** in September to finalise the prototype of the method.
- **Test of the prototype** in the **Orféa** project in east of France (funded by PEI).

Thank you for your attention