# Farmers' Risk Perception & Beliefs about Pesticide Reduction

A Framed Field Experiment

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# Usual assumptions

**In this literature, we often assume**

- farmers' pesticide use decisions are decisions under risk
- We can measure Risk attitudes via behaviroal tools
- overtreatment possibly driven by risk attitudes

**By measuring risk attitudes precisely, we can identify one of the causes of pesticide use and help design a reduction policy. But in reality**

# But in reality...

- Our tools have limited external validity
- Farmers face many **constraints**
- Pesticide use is often **not** a choice!
- Farmers**know much more than we do** about their farm

**We chose to build a protocol that is as contextualized as possible; we mobilize our behavioral knowledge within the constraints of farmers' activity.**

We chose
high external and contextual validity
but
low to no generalizability

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(it's fine: we have no power anyway)

# Research questions

1. How do farmers **perceive** the risk of attack?
2. How do these perceptions influence the **amount of pesticides** they apply?
3. What role does **information** (data on attack risk) play in shaping their decisions?
4. Can these **insights** can be used to design effective **policies** for pesticide reduction?

# Two key challenges for our study

**Descriptive:** Which role for risk attitudes in farmers' reluctance to reduce pesticides? **(FAST WP1)**

- Risk **perception**: do they estimate pest risk correctly?
- **Beliefs**: quantity and quality of yields conditional on treating/not treating
- Are they responsive to "objective" external **information**?

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**Normative:** Potential for the design of more effective behavioral public policies. **(FAST WP4)**

- Nudge, boost, information provision, advice... **accounting for beliefs**...

# Experiment within the ANR project FAST

- Pesticides: environmental and health risks
- Public policies Ecophyto (I, II, II+) not very effective
- Literature on standard incentives (taxes, subsidies, price regulation)
  Femenia and Letort (2016), Finger et al. (2017), Pelaez et al. (2013)
- Behavioral literature
  Chèze et al. (2020), Bontemps et al. (2021), Couture et al. (2024), Schaak et al. (2024)
  - Decontextualized choices – or contextualized via DCE
  - No *focus* on beliefs: only on risk preferences
  - No *focus* on information provision

# The experiment

# The general methodological choices

- **Risk tasks have little external validity**: it is up to *us* to innovate
- **Farmers don't have much choice**: it is up to *us* to find the right context
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# General spirit of the experiment: a vignette study

For a precise situation where the farmer decides **if and how much** to treat, we will:

1. Measure their **risk perception** in the situation
2. Measure their **beliefs** regarding quantity/quality losses if impacted and untreated
3. Measure their **willingness to treat** as a function of **pesticide price**
4. Provide **external expert information** on attack risk
5. Measure a **second time** their intention to treat (conditional on price)

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+ **Questionnaire** about the farmer's profile
(socio-demo, farm size, etc.)

## But we need a precise choice situation!

We need a situation where:

- the farmer truly has a choice
- there is a real economic stake
- the situation is ambiguous: treating vs not treating are both viable
- farmers may overtreat due to risk perception
- information provision could reduce pesticide use
- the crop is widespread enough to matter

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**Fungicides in soft wheat**

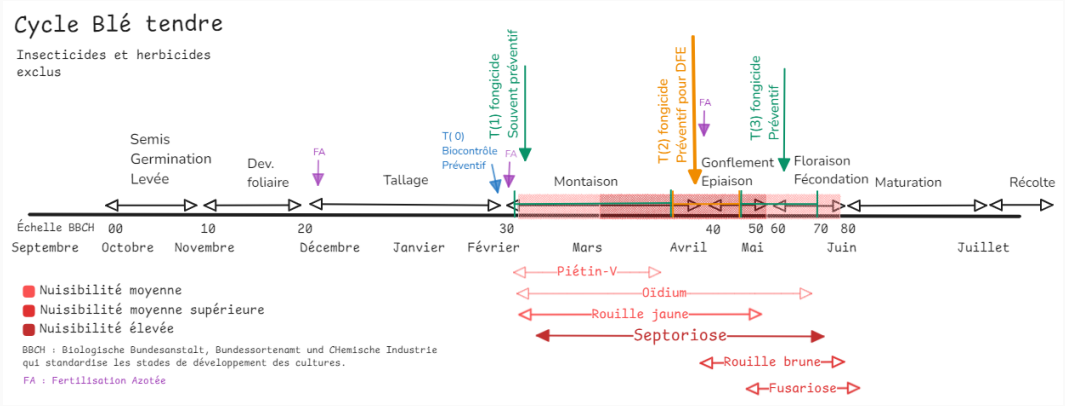
# Quick overview of pesticides in wheat: fungicides

**Fungicides target different diseases at each stage ($T_1$, $T_2$, $T_3$)**:

- Fungicide at $T_1$ impacts 4–15% of the yield per hectare ($\sim$5–18%)
- Fungicide at $T_2$ combats a major disease: impacts at least 15% of yields
- Fungicide at $T_3$ is preventive: reduces quality (humidity, temperature). If farmers can skip it, they do

**Translated into our economist language:**

- *Intertemporal* and *risky* decision-making across three points in time
- Farmer objective: maximize yield under constraints (pesticide price, uncertain environment)


Cycle Blé tendre
Insecticides et herbicides exclus
Semis
Germination
Levée
Dev. foliaire
FA
Tallage
T( 0) Biocontrôle Préventif
T(1) fongicide Souvent préventif
FA
Montaison
T(2) fongicide Préventif pour DFE
FA
Gonflement
Epiaison
T(3) fongicide Préventif
Floraison
Fécondation
Maturation
Récolte
Échelle BBCH 00 10 20 30 40 50 60 70 80
Septembre Octobre Novembre Décembre Janvier Février Mars Avril Mai Juin Juillet
Piétin-V
Oïdium
Rouille jaune
Septoriose
Rouille brune
Fusariose
Nuisibilité moyenne
Nuisibilité moyenne supérieure
Nuisibilité élevée
BBCH : Biologische Bundesanstalt, Bundessortenamt und CHemische Industrie qui standardise les stades de développement des cultures.
FA : Fertilisation Azotée

# Contextualized choice situations – vignettes

**Fictional scenario based on a real case:** a critical moment when the farmer must decide how much pesticide to apply depending on perceived attack risk.

**Variables used to build scenarios:**

- previous week's weather + next week's forecast
- yield potential: high, medium, low
- wheat price
- varietal sensitivity: rather resistant or not
- previous crop: maize, ...
- market outlet: human, animal...

**These variables are manipulated to observe behavior across sufficiently diverse scenarios.**

# Overview of choice situations

**Table 1:** Scenarios and expected behavior

| Treatment | Number of scenarios | Expected behavioral outcome |
|---|---|---|
| $T_1$ (early stage) | 4 | 1 no treatment<br>1 full treatment<br>2 heterogeneous behaviors |
| $T_3$ (late stage) | 4 | 1 no treatment<br>1 full treatment<br>2 heterogeneous behaviors |
| **Total** | 8 | – |

**Scenarios are block-randomized: first $T_1$, then $T_3$.**

# Choice situation at $T_3$ (example)

*It is May 27, in Île-de-France, at the beginning of the phenological stage.*

**Weather from the previous week**

| **Date** | **Weather** | **Rainfall** (mm) | **Humidity** (%, min/max) | **Temperature** (°C, min/max) |
|---|---|---|---|---|
| Wed 20 |  | 0 | 45 / 72 | 12 / 20 |
| Thu 21 |  | 5 | 65 / 88 | 13 / 19 |
| Fri 22 |  | 1 | 50 / 80 | 11 / 18 |
| Sat 23 |  | 8 | 70 / 94 | 14 / 21 |
| Sun 24 |  | 0 | 40 / 75 | 13 / 22 |
| Mon 25 |  | 3 | 55 / 83 | 12 / 18 |
| Tue 26 |  | 2 | 52 / 81 | 11 / 19 |

**Weather forecast for the next week**

| **Date** | **Weather** | **Rainfall** (mm) | **Humidity** (%, min/max) | **Temperature** (°C, min/max) |
|---|---|---|---|---|
| Wed 28 |  | 0 | 42 / 74 | 12 / 21 |
| Thu 29 |  | 2 | 50 / 82 | 11 / 19 |
| Fri 30 |  | 4 | 60 / 87 | 13 / 20 |
| Sat 31 |  | 7 | 72 / 95 | 14 / 22 |
| Sun 1 |  | 0 | 38 / 71 | 12 / 23 |
| Mon 2 |  | 1 | 48 / 78 | 11 / 18 |
| Tue 3 |  | 3 | 58 / 84 | 13 / 19 |

## Choice situation at $T_3$ (example)

**Yield potential** medium

**Wheat price** €200/ton

**Varietal sensitivity** moderately sensitive

**Previous crop** maize

**Tillage** no plowing, residues on the surface

**Treatment history** (T3 only)

- $T_1$: adjusted dose ($\sim$0.7 L/ha of recommended dose)
- $T_2$: full dose (1 L/ha)

**Market outlet** animal feed

*Given this information, please evaluate the risk of an attack over the next 7 days by placing the cursor on the scale:*


*In this scenario, please indicate the dose of fungicide such as Prosaro (Prothioconazole-based) you would apply (select 0 L/ha if none):*

| 0 L/ha | $\leq$ 0.5 L/ha | 0.7 L/ha | 1 L/ha | 1.2 L/ha |
|---|---|---|---|---|
| | | | | |

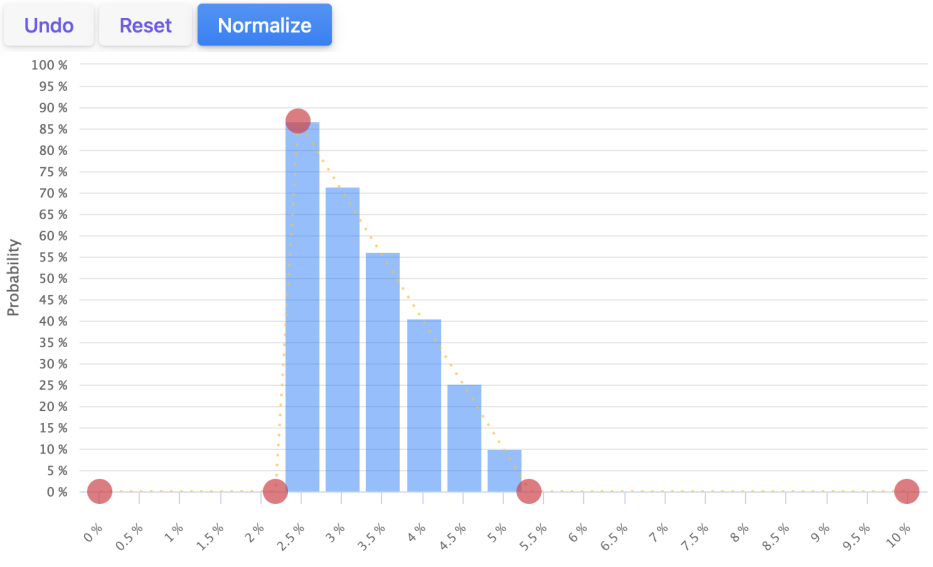
## 2. Beliefs about uncertain events

- $T_1$ **scenarios:** distribution of expected yield *quantity* (tons/ha), based on the farmer's declared dose
- $T_3$ **scenarios:** distribution of expected *quality*, based on the declared dose

**Belief elicitation tool:**

- *Click-and-Drag* (Crosetto and de Haan 2023)
- interface link here, or screenshots in the following slides

Predict using the interface: what will the **inflation** in the **Euro Area** in **2023** be?



# 2. Beliefs about uncertain events

**Subjects who chose $> 0$ L/ha have a second belief elicitation task:**

- Counterfactual case where pesticide dose $= 0$ L/ha

**This addresses a key research question:**

- Do farmers tend to *overestimate* attack risk?

(Screenshot on next slide)

Predict using the interface: what will the **inflation** in the **Euro Area** in **2023** be?

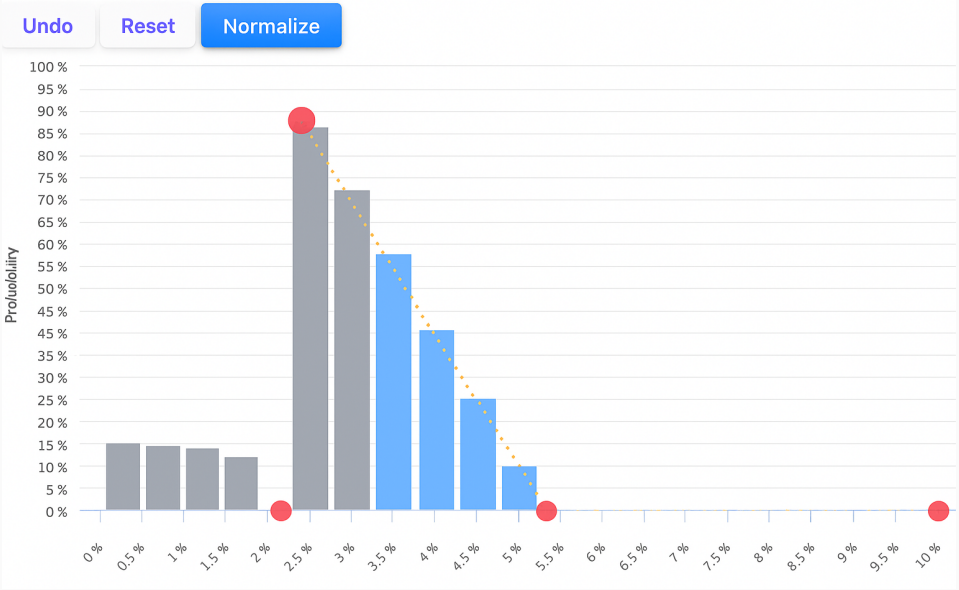
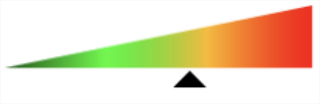


**Table 2:** Pesticide dose by price

| Price (€/ha) | 0 L/ha | <0.5 L/ha | 0.7 L/ha | 1 L/ha | 1.2 L/ha |
|---|---|---|---|---|---|
| 15 | | | | | |
| 20 | | | | | |
| 25 | | | | | |
| 30 | | | | | |
| 35 | | | | | |
| 40 | | | | | |
| 45 | | | | | |

# 4. Information provision

*Here is the attack risk estimated by Arvalis:*



*Note:* the exact illustration will be specified later.

*In this scenario, please indicate the dose you would apply (select 0 L/ha if none). Treatment concerns a fungicide such as Prosaro (Prothioconazole-based). I would apply:*

| 0 L/ha | $\leq$ 0.5 L/ha | 0.7 L/ha | 1 L/ha | 1.2 L/ha |
|---|---|---|---|---|
| | | | | |

+ their confidence in the information provided by *Arvalis* (0–10 Likert scale)

# What do we do with the data?

**perception** descriptive risk perception, comparison with experts

**beliefs** descriptive expected impact of treatment, comparison with experts

**Price list** potential impact of pesticide taxes given beliefs

**Info** reaction of (1) and (3) to information, potential behavioral change

# The experiment

**Subjects:** $N \approx 100$ soft-wheat farmers

**Recruitment:** *Agropithiviers*, farmers' cooperative in Pithiviers (Centre-Val de Loire)

**Incentive:** flat payment ($\sim$ €20), no incentive on decisions due to contextualization

**Format:** online, or possibly in-person (tablet sessions in Pithiviers)

**Duration:** $\sim$1h

**Test version of interface:** end of 2025, developer: Émilien or Ismaël

**Sessions:** early 2026

Thank you for your feedback