# Is the planting of pesticide-treated seed profitable? Results from a large-scale farmer-led arable cropping system experiments in Northeast France

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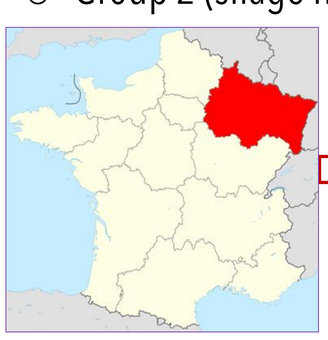
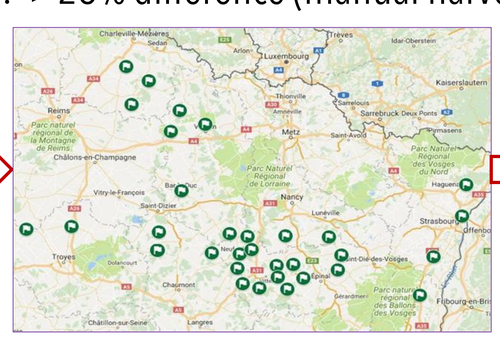
## Background

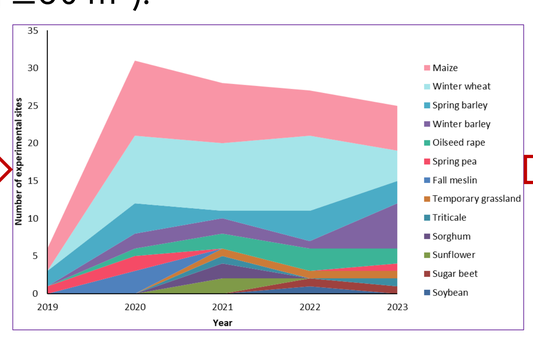
Use of pesticide seed treatments to avert yield loss by managing seed and seedling pathogens has become increasingly common practice worldwide (Hitaj *et al*., 2020). In France and Europe, pesticide seed treatments are considered in the calculation of the treatment frequency index (TFI) only since 2017 meaning that the planting of pesticide-treated seed leads to a TFI = 1 (Lamichhane and Laudinot, 2023). On the other hand, little is known about agronomic and environmental benefits *vs.* drawbacks of planting pesticide-treated seed although recent studies report negative effects of this practice on human health and biodiversity (Lamichhane *et al*., 2020). A detailed knowledge about the economic risks of adopting cropping systems without pesticide seed treatments would help decision making of farmers about the need or not of planting pesticide-treated seed. Because this practice has a cost for farmers, its optimized use will provide them direct and indirect advantages. For example, eliminating pesticide seed treatments when they are not needed not only reduces production costs for farmers but also allows them to reduce the TFI of their crops. A reduction in the TFI, in turn, allows their access to agri-environmental and climate schemes, which is a contract providing farmers with financial support in return for adopting low-input and environmentally-friendly farming practices as an instrument of the EU's common agricultural policy.

## Materials and Methods

- A 6-year (2019-2024) project to assess the feasibility of cropping systems without fungicide seed treatments compared to a control.
- 32 experimental sites (average size 3 ha/site), characterized by contrasted environmental conditions and cropping practices, to conduct on-farm trials in the Grand Est region, Northeast of France.
- Crop rotation adaptation according to farmer's objectives and climatic conditions (i.e. no *a priori* decision about crop rotation).
- Each site divided in two equal parts (average size 1.5 ha/treatment), one part sown with treated and another with non-treated seeds.
- 13 crop species planted with a different frequency in the rotation across the experimental sites.
- Record of all key explanatory variables related to soil, climate and cropping practices over the rotation.
- A specific threshold defined for each crop group to determine the significant difference in yield between the two treatments.
  - Group 1 (straw cereals, oilseed rape, sunflower and grain maize): 5 q/ha threshold (harvest measured over an area ≥ 0.6 ha/treatment),
  - Group 2 (silage maize): >25% difference (manual harvesting ≥30 $m^2$).





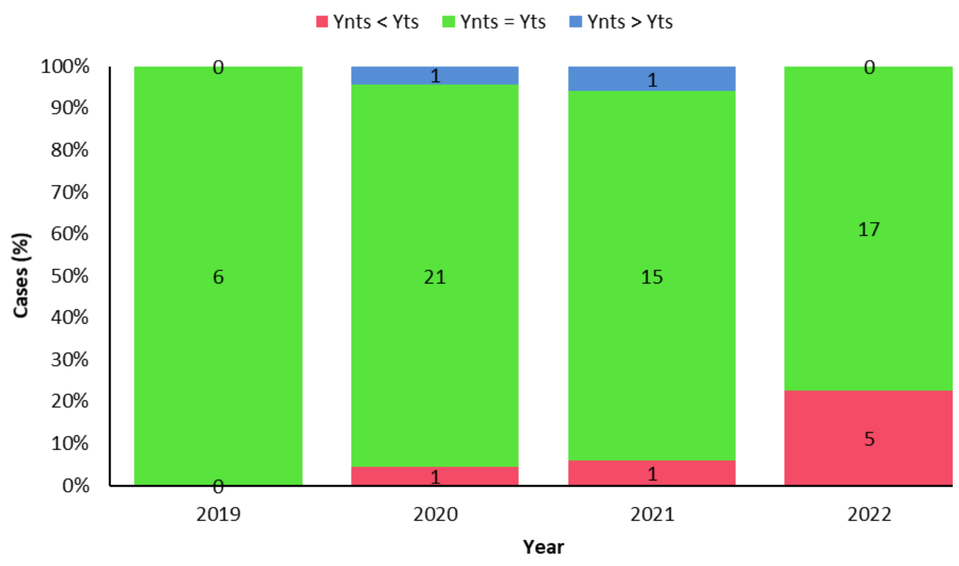




**Measured variables:**

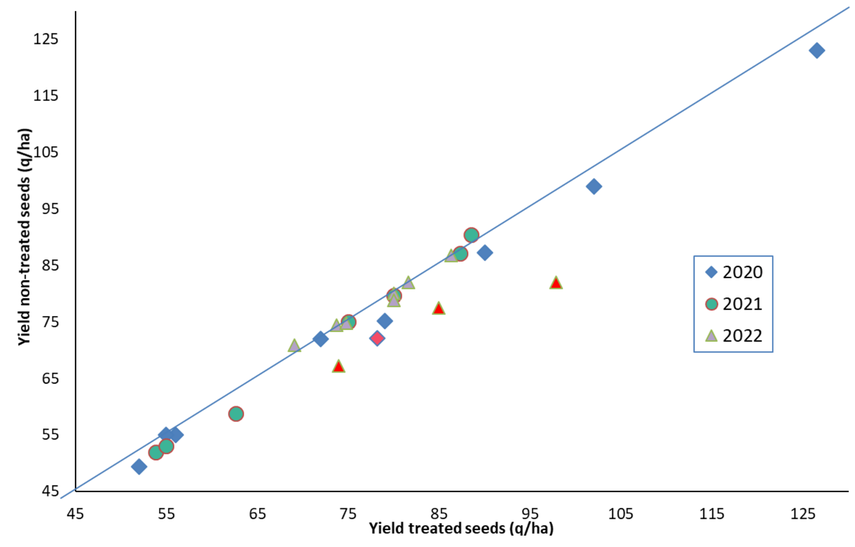
- Emergence rates (%)
- Time to emergence (days)
- Soil physico-chemical characteristics
- Soil microbiological features (biomass, diversity and fungi-oomycetes/bacteria ratio)
- Number of earthworms
- Yield (quantity and quality)

## Results

- Rare yield penalties in the absence of pesticide seed treatment.
- In 89% of cases (for all crops combined), Ynts = Yts. In 2022, Ynts < Yts in 23% of the sites (5 out of 22).
- Over the 2020-2022 period, Ynts < Yts in 4 out of 26 plots for soft winter wheat. For 2 out of 4 sites, a high rate of emergence losses occurred with no compensation via tillering in 2022 leading to a significantly lower ear stands in plots sown with non-treated seeds compared to those planted with treated seeds.




Share of cases reporting differences in yield obtained between non-treated seeds (Ynts) and treated seeds (Yts). The number in the histogram represents the number of experimental sites.




Effect of fungicide seed treatment on soft winter wheat yield compared to non-treated control. The red color indicates significant differences in yield between non-treated seeds (Ynts) and treated seeds (Yts). The yield difference is considered significant with regard to the threshold of 5 q/ha.

## Conclusion and perspectives

- Original experimental device based on a large-scale farmer-led arable cropping system experiments on a multi-year and systemic scale to explore the effect of pesticide seed treatments in the technical, economic and environmental performance of representative cropping systems in the Grand Est region.
- While still preliminary, results show a clear trend that the systematic use of pesticide seed treatments for all crops does not increase the farm profitability.
- The predictability of risk factors requires an in-depth analysis integrating variables related to soil, climate and cropping practices.
- Under high-risk situations, the possibility of replacing pesticide-treated seed with biological seed treatment products needs to be explored.
- Besides yield, an in depth analysis on the effect of planting pesticide-treated seed on soil biodiversity is required.
- A multi-criteria assessment will allow to draw robust conclusions related to benefits *vs.* risks of planting pesticide-treated seed.

**References:**

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