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► To cite this version:

Alexandre Joannon, Aziz Djoudi El, Alexandre Monteiro, Augustine Perrin, Julien Pétilon, et al.. Diversity of wheat crop management from conventional to organic farming: socio-economic and ecological assessment. Organic World Congress 2021, Sep 2021, Rennes, France. hal-04668936

HAL Id: hal-04668936

<https://hal.science/hal-04668936v1>

Submitted on 7 Aug 2024

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DIVERSITY OF WHEAT CROP MANAGEMENT FROM CONVENTIONAL TO ORGANIC FARMING: SOCIO-ECONOMIC AND ECOLOGICAL ASSESSMENT.



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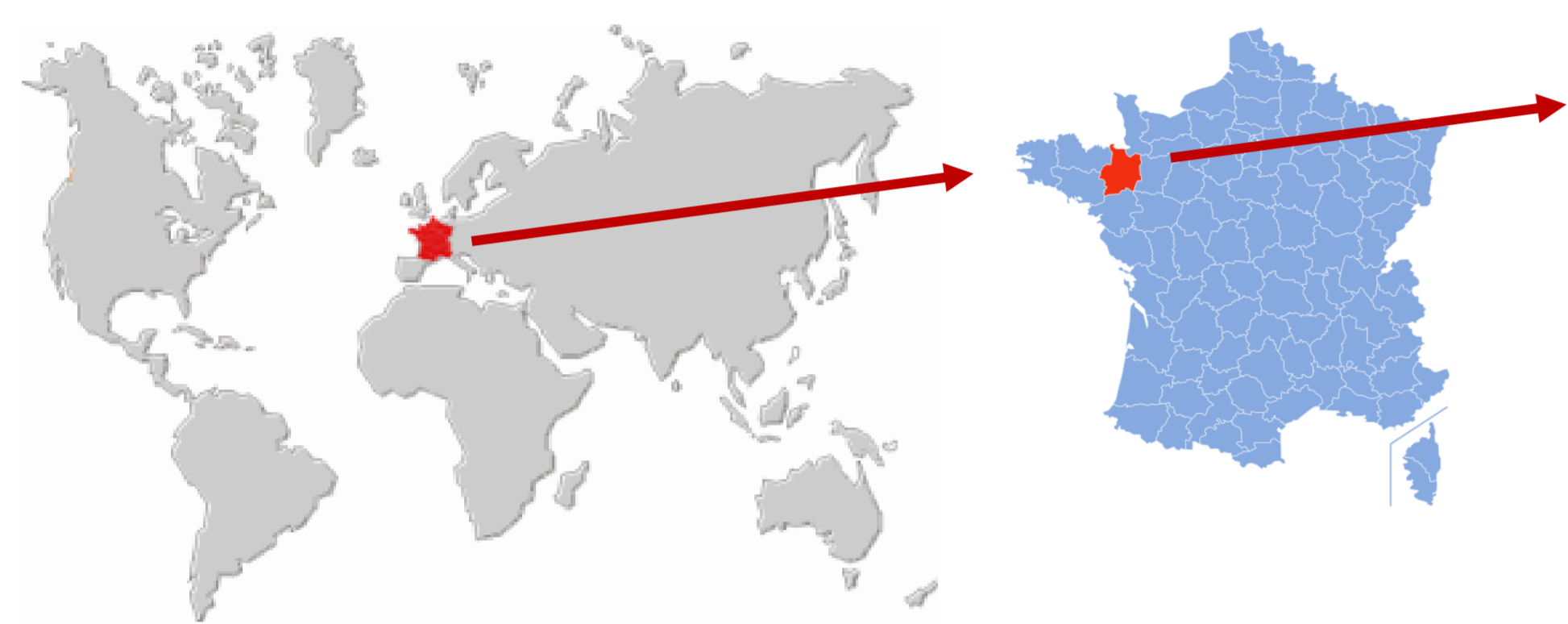
Introduction

Enhancing biological control of crop pests by their natural enemies is considered a promising strategy to increase the sustainability of agricultural systems. Studies assessing the impacts of farming practices on natural enemies and pest regulation processes often compare organic and conventional crops. However, such comparisons do not allow to take into account the diversity of cropping systems and management strategies implemented by farmers in both organic and conventional production systems. Moreover socio-economic aspects of cropping systems are rarely assessed.

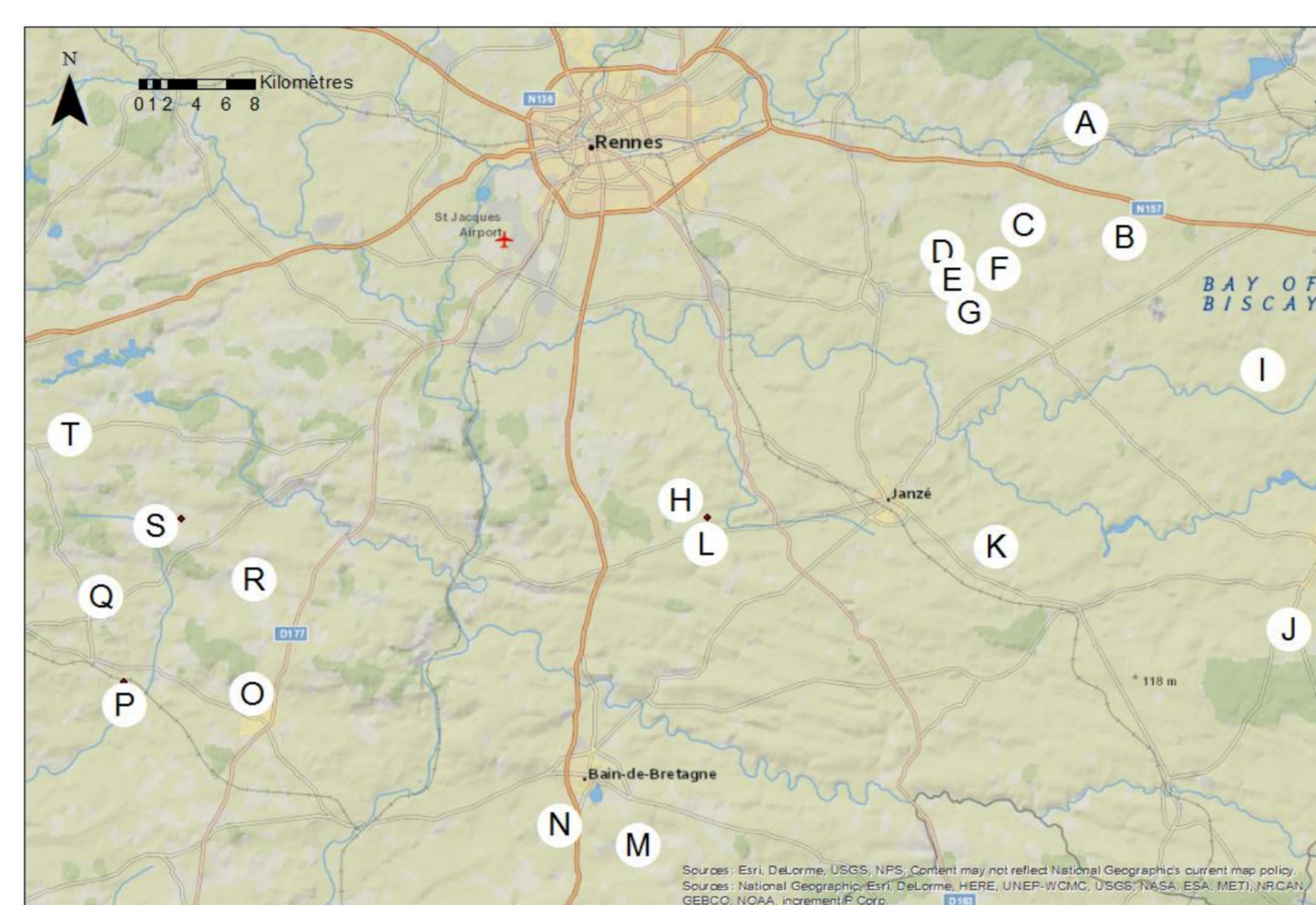
The aim of our research was then to assess the diversity of natural enemies and levels of biological control in a diversity of organic and conventional wheat fields, considering farmers' practices, labor and economic aspects related to wheat management in those fields.

Material and Methods

Study area



20 sites located in the Zone Atelier Armorique (Long Term Socio-Ecological Research site), in Brittany, France.



Ecological surveys

Sampling was conducted in 20 pairs of organic and conventional winter cereal fields in 2016.

Carabid beetle communities were sampled using pitfall traps from April to July.

During the same period, **pest predation rates** were quantified using sentinel prey experiments (pea aphids: *Acyrtosiphon pisum*; seeds of field pansy: *Viola arvensis*).

Cropping system characterization

A **typology of cropping systems** was realized using combined FAMD (Factor Analysis of Mixed Data) and HAC (Hierarchical Ascendant Clustering) on several variables :

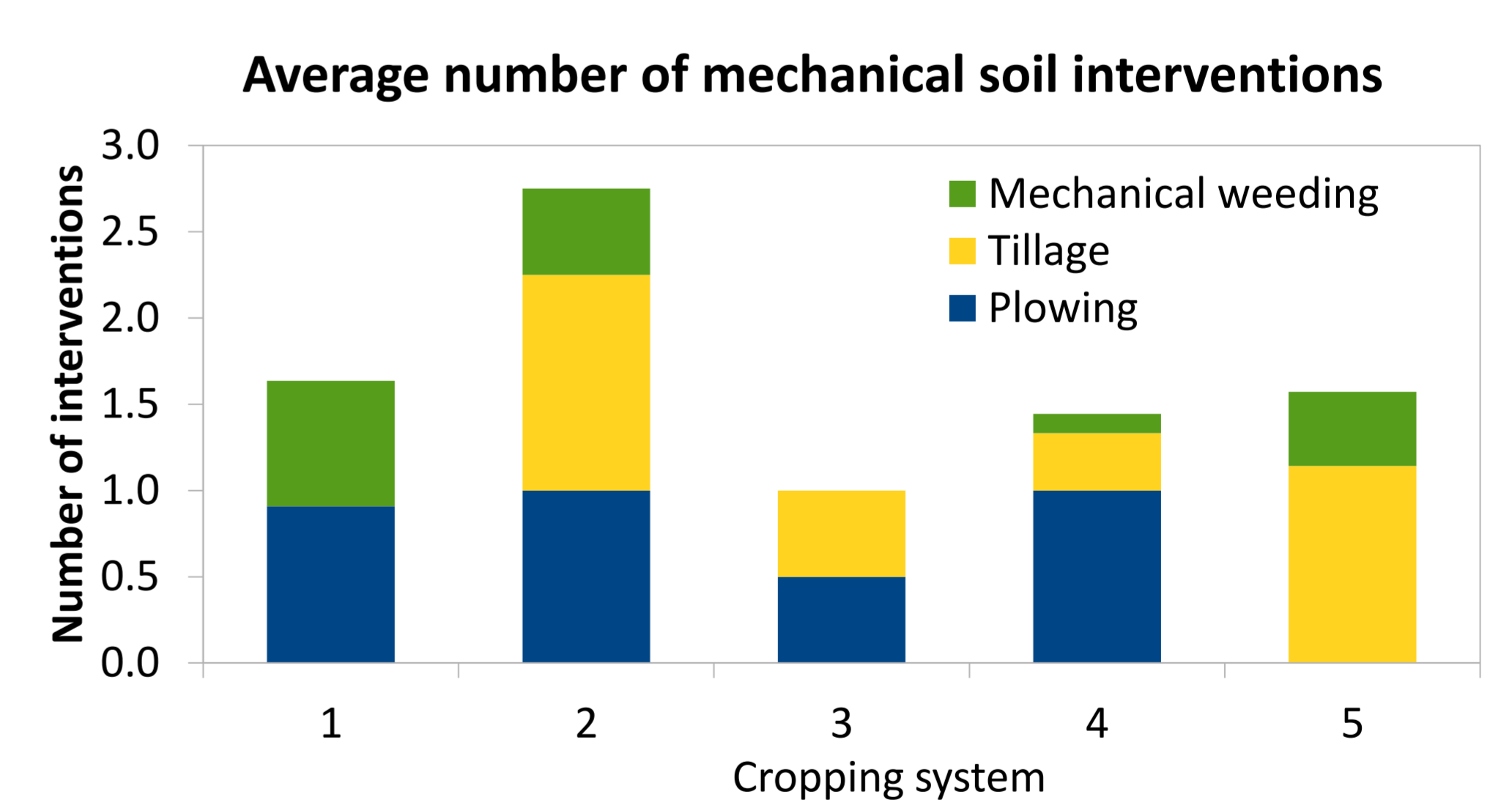
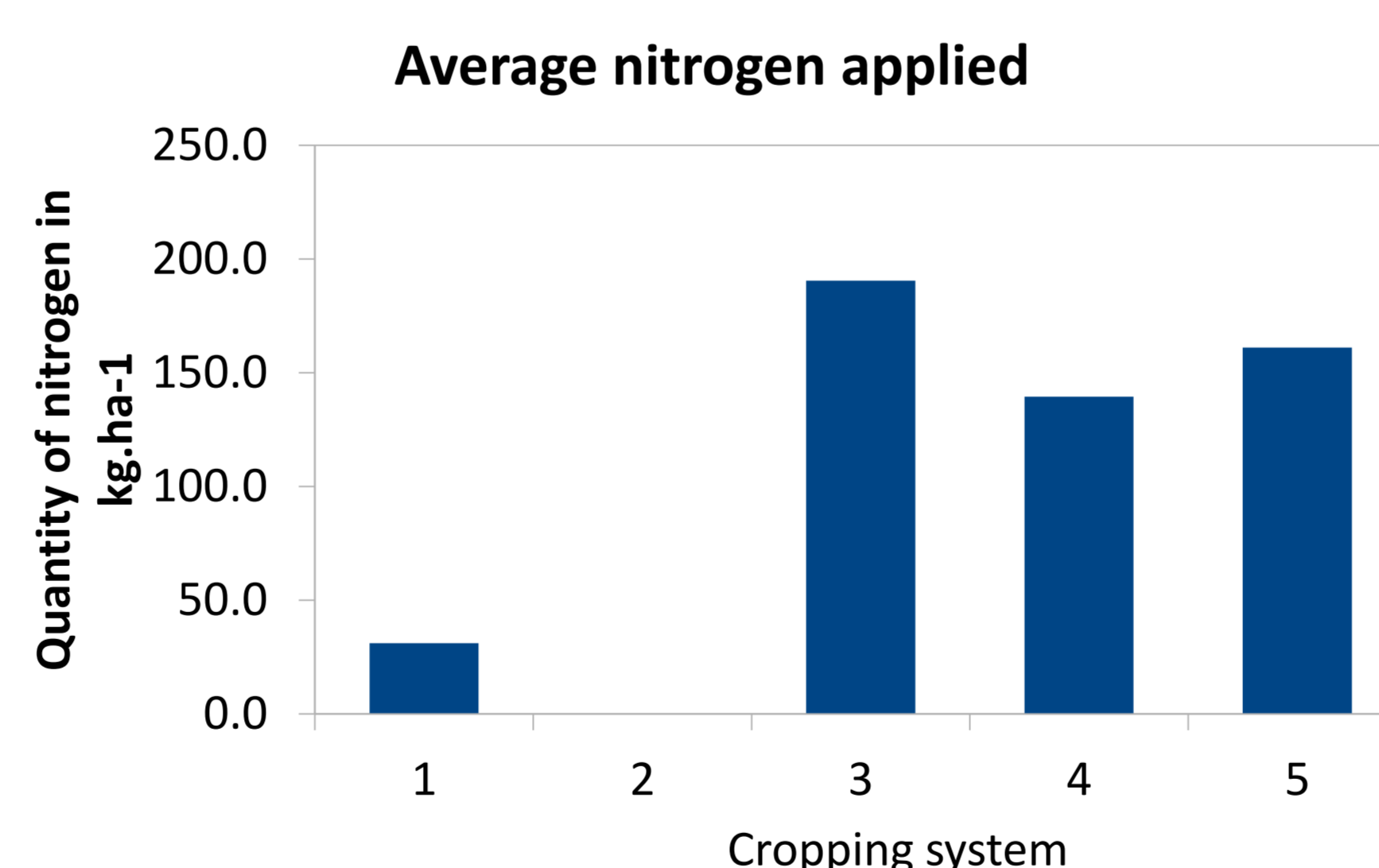
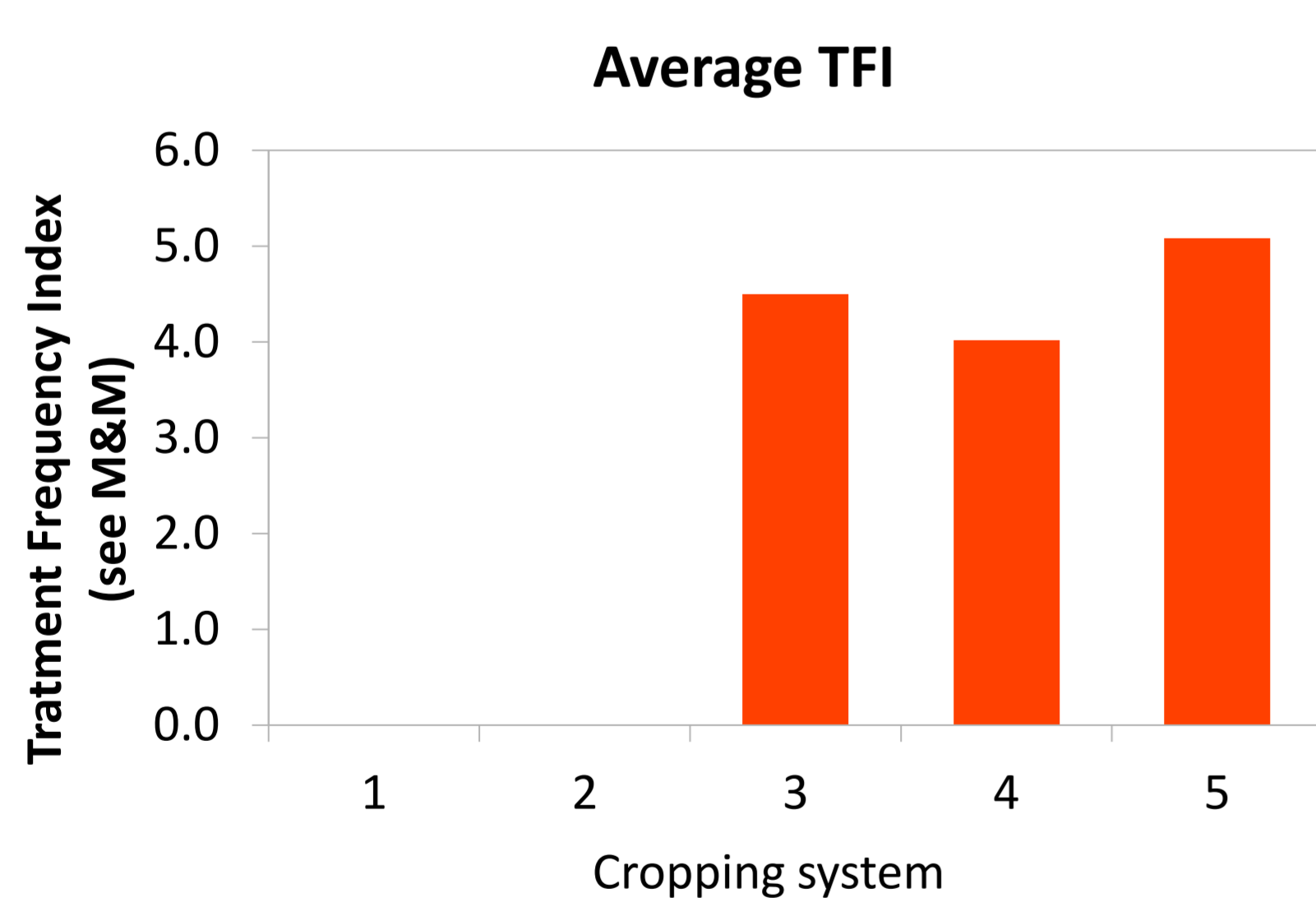
- Descriptors of farming practices : plowing and tillage frequency, mechanical weeding, nitrogen fertilization, pesticide treatments.
- Descriptor of crop productivity : crop yield.
- Socio-economic indicators : margin and in-field work duration.

| Variables | Description |
|-----------|---|
| Plow | Plowing frequency |
| Till | Tillage frequency |
| MW | Mechanical Weeding frequency |
| UN | Quantity of nitrogen applied in kg.ha ⁻¹ |
| TFI | Treatment frequency index: ratio of pesticide standard concentration to pesticide concentration actually sprayed |
| Yd | Yield in t.ha-1 estimated by farmers |
| Ma | Margin (€.ha ⁻¹): [Gros Product minus (Operating Cost and Machinery Cost)]. Product and costs were calculated based on local prices and on french database. |
| WD | In field work duration (h.ha-1): based on 2015 French references |

Results and discussion

We identified **5 types of cropping systems** : 2 organic (types 1 and 2) and 3 conventional ones (types 3 to 5).

- **Among organic systems**, almost all fields were plowed, but no other tilling was done in type 1 ; in type 2 no nitrogen was applied.
- **Among conventional systems**, type 4 was the least intensive (low tillage, pesticide use and nitrogen fertilization) but plowing was systematically done ; type 5 was the most intensive (tillage, mechanical weeding and pesticide use) but plowing was never implemented ; Type 3 has a high level of nitrogen fertilization.

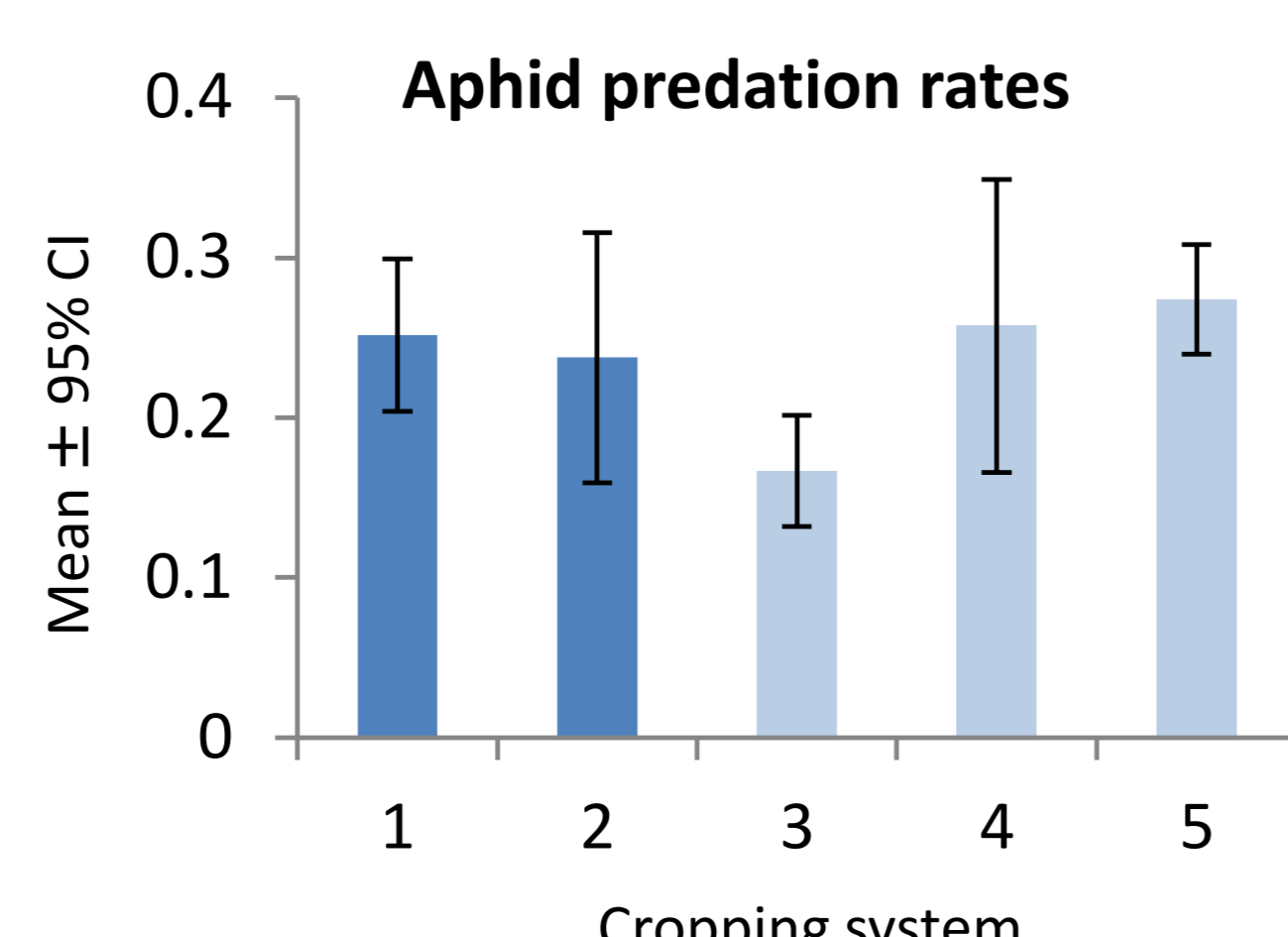
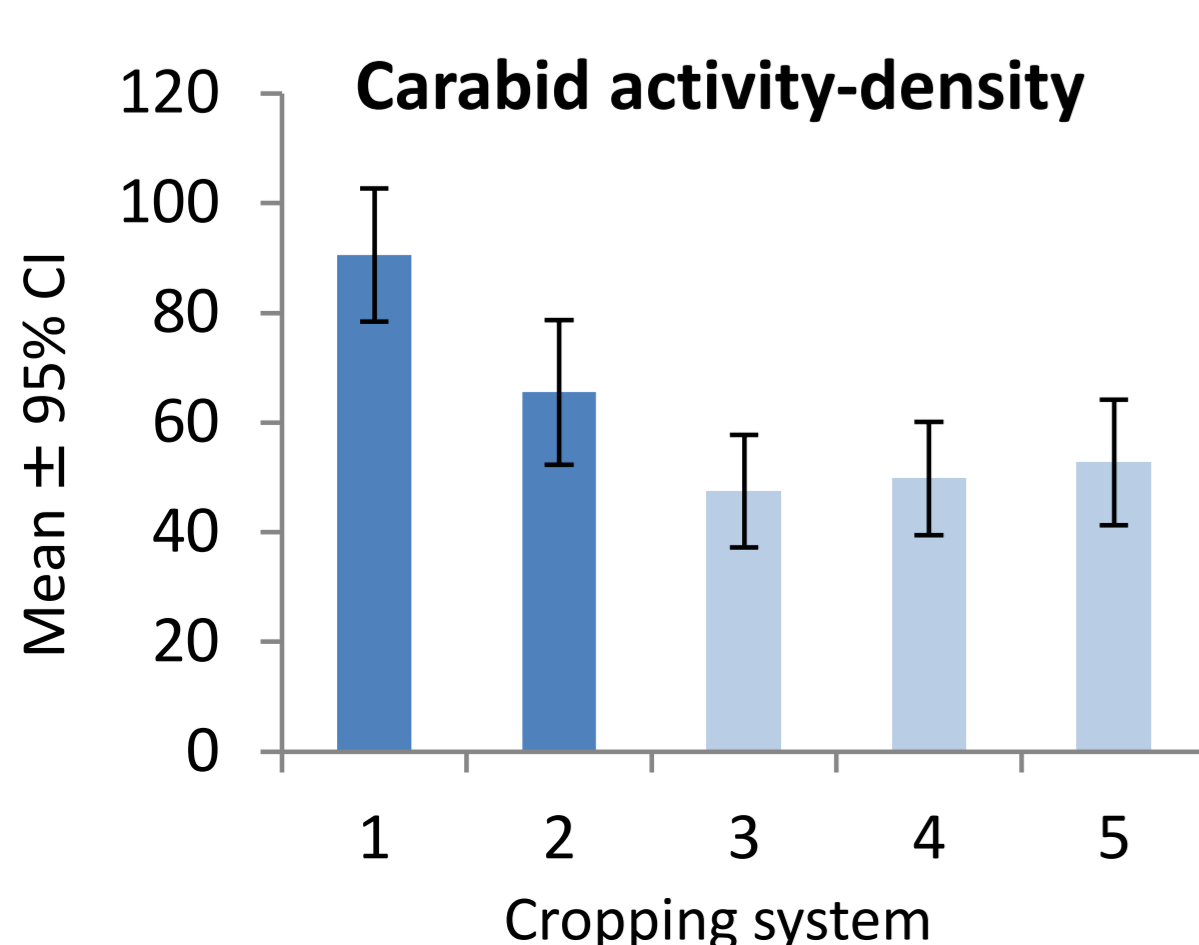


Regarding **crop productivity**, yields in organic wheat fields were lower than in conventional ones, but **margins were higher** due to higher selling price and lower operating and machinery costs.

Work duration was similar among all types of cropping systems and even slightly lower in type 1 contrary to what is often thought.

Yield, margin and in-field work duration for the 5 types of cropping systems

| | Type 1 | Type 2 | Type 3 | Type 4 | Type 5 |
|----------------|--------|--------|--------|--------|--------|
| Yield (t.ha-1) | 3,8 | 3,3 | 7,1 | 6,9 | 7,5 |
| Ma (€.ha-1) | 943 | 826 | 572 | 632 | 732 |
| WD (h.ha-1) | 2,5 | 3,0 | 3,1 | 3,3 | 3,0 |



Organic cropping systems were overall **beneficial for the diversity and abundance of carabid beetles** in cereal fields, but this positive effect was only related with cropping systems with reduced soil disturbance (type 1) .

Pest predation rates were similar in organic and conventional fields, but aphid predation rates were reduced in conventional systems with higher levels of N fertilization.

The contrasted pattern between carabid and predation responses suggest that carabid beetles were not the only natural enemies contributing to prey predation.