CORE organic

# AGronomical and TEChnological methods to improve ORGanic wheat quality

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# Background

- ✓ Organic bread-wheat sector faces high demand in Europe inducing large imports
- ✓ Requirements from processors and consumers on quality and safety aspects are getting higher
- ✓ Organic wheat was characterized by low and variable yield and grain protein content

- ➢ Ways to improve baking performance and nutritional value of organic wheat-flour & to prevent mycotoxin contamination ?

# Innovative ways of applied research

## Long term experiments

- DOK Trial (Fibl-FAL) 1978-
- CROPSYS Trial (AU) 1997-
- MUBIL Trial (BOKU) 2003-
- SoilMan Trial (ISARA-ESA) 2004-

## Transnational field experiments

N management, green manuring and insertion of legumes

N fertilization (AU, FIBL, FAL, ISARA)

Green manure (AU, BOKU)

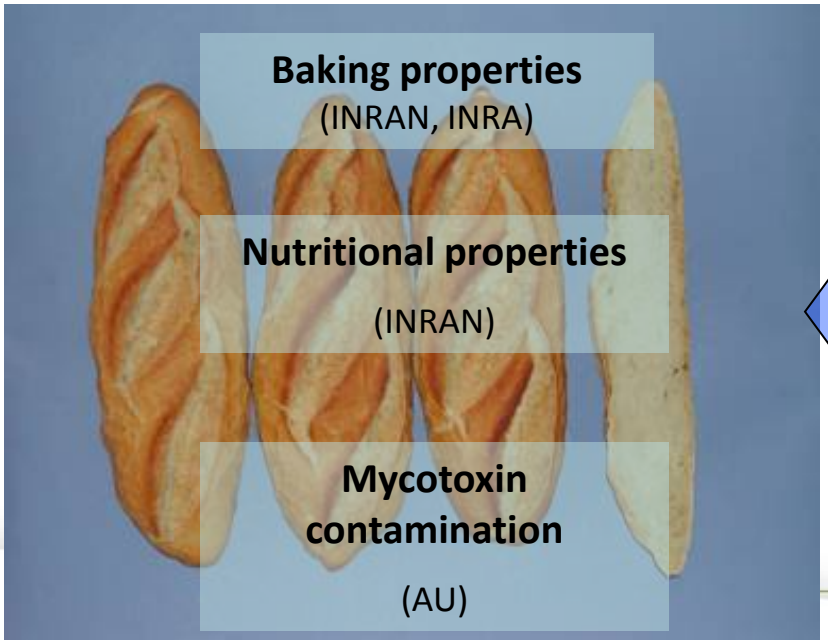
Intercropping (ESA, ISARA, FAL)

Soil tillage management (ISARA, ESA, FIBL)

## Post-harvest treatments

(INRA, INRAN, Goëmar)

- Milling process –stone vs roller
- Ozonation and heat treatments



**Baking properties**
(INRAN, INRA)

**Nutritional properties**
(INRAN)

**Mycotoxin contamination**
(AU)

# Example 1. Effect of soil tillage management on wheat performance

## Grain yield

***Frick tillage Trial***

| | Winter wheat 2003 | Winter wheat 2009 |
|---|---|---|
| **Reduced tillage** (plough 100%) | 86% | 122% |

***Thil tillage Trial***

| | Winter wheat 2007 | Winter wheat 2009 |
|---|---|---|
| **Reduced tillage** (plough 100%) | 122% | 76% |

***ESA tillage Trial***

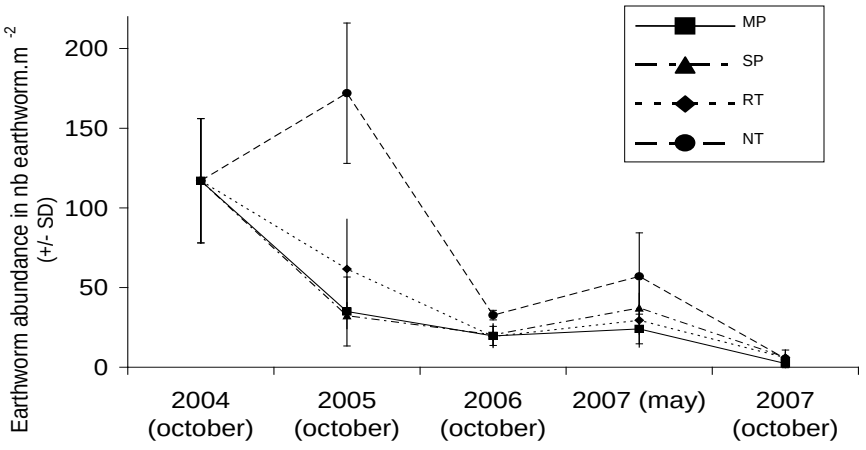
| | Winter wheat 2008 |
|---|---|
| **Reduced tillage** (plough 100%) | 43% |

**Reduced tillage (RT) vs. Plough (MP)**

**Three long term trials** Started 2002 continued

**Reduced tillage** - shallow tillage at 5cm and occasionnaly at 15 cm

**Plough –** Traditional ploughing between 15 to 30cm depth



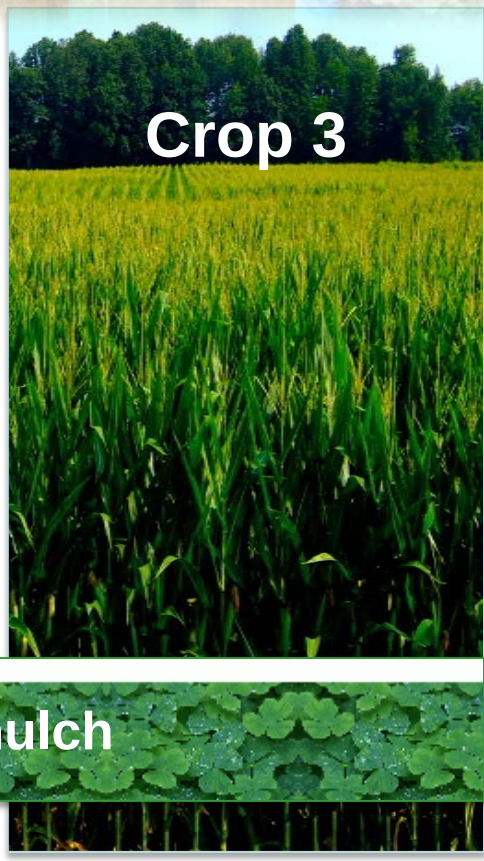

Source: FIBL, ISARA, ESA under publication

**Reduced tillage (RT) vs. Plough (MP)**

- ✓ Yields : **high variability** with RT(43% to 122%)
- ✓ **Better soil structure**
  - ✓ Higher microbial biomass in 0 -10cm
  - ✓ Higher organic matter in 0-30 cm
  - ✓ Higher earthworm density and activity with direct seeding with cover crop
- ✓ **More weeds**
- ✓**Risk of soil compaction** under sandy and silt soils
- ✓ **Good baking value** with higher gliadin/glutenin ratio
- ✓**Minor differences** in production costs

# Example 2. Effect of legume intercrops on wheat performance






**Three modes incorporating legumes in grain rotation have been compared**

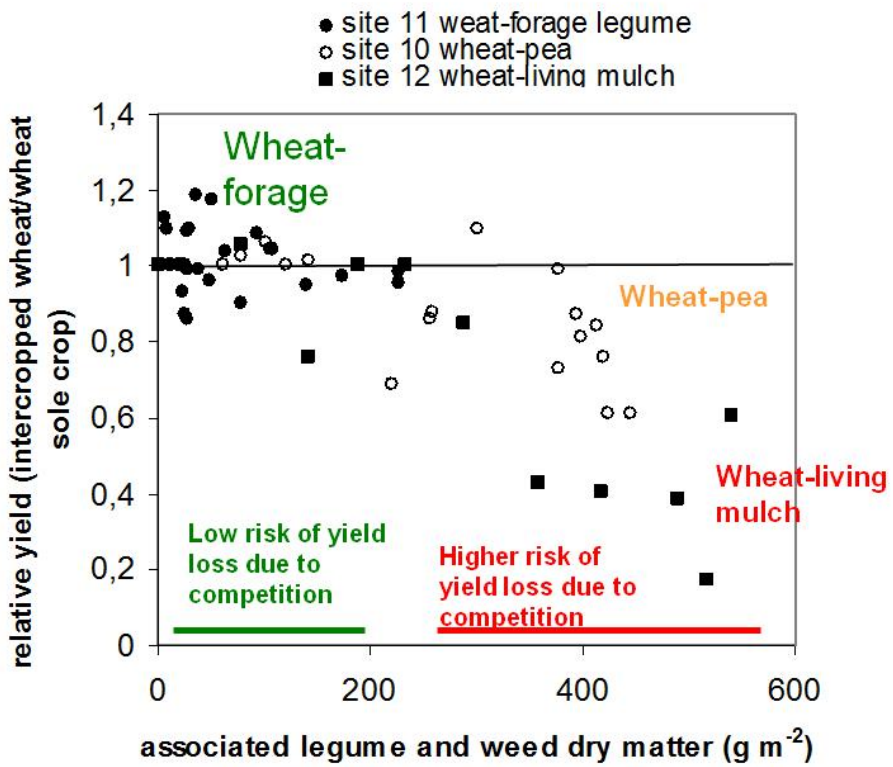
**Type 1.** Wheat-Pea intercrops
**Type 2.** Relay cropping with undersown forage legumes
**Type 3.** Wheat sown in a living mulch of legume

**Others threatments :**

**Fertilization management** additional N or no N
**Type of legume**
**Wheat-Pea Ratio (30/70 – 50/50 – 70/30)**

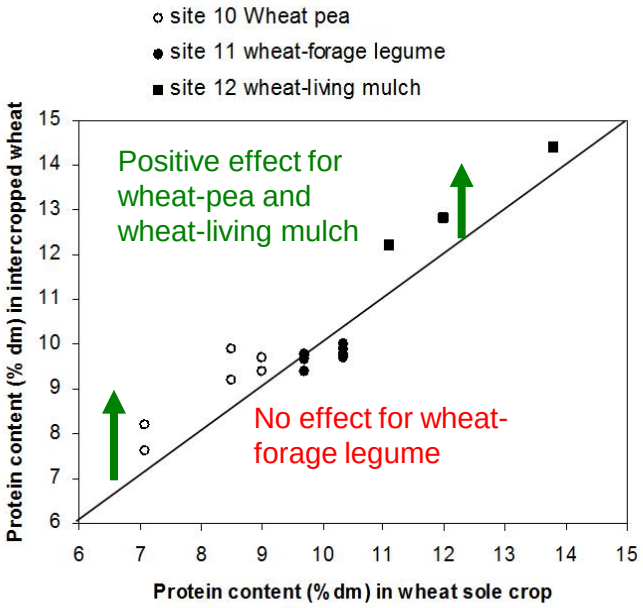
**12 sites – 105 treatments**

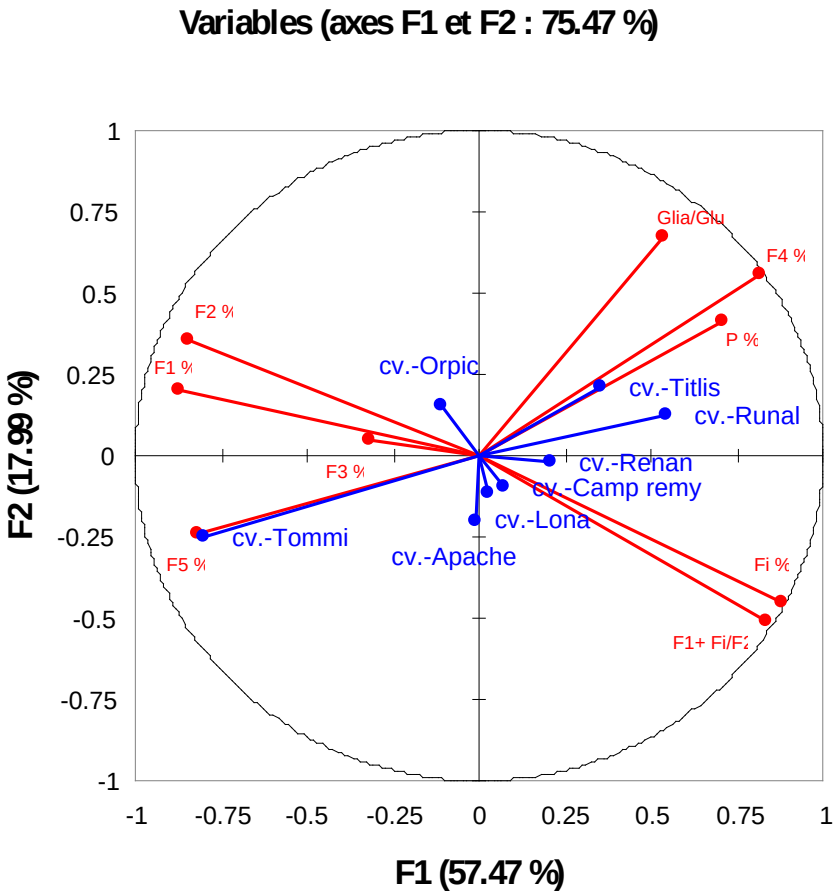
# Example 2. Effect of legume intercrops on wheat performance




Source: Hellou et al. under publication

- ✓ Positive effect on the cumulative yield LER =1.3 for wheat-pea
- ✓ Competition on ressources (water and nutrients) impaired wheat yield … and weeds
- ✓ **Protein content :**
  - ✓**Positive effect** (Wheat-Pea ,Wheat-Living mulch) or **No effect** (wheat forage)
- ✓**Improvement** of quality parameters






# Summary

- ✓ Strong influence of cultivar on yield and quality parameters

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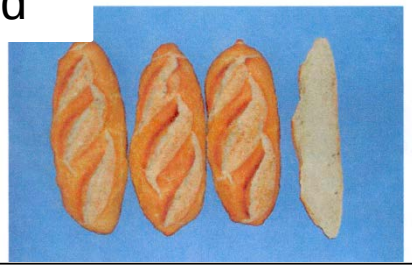
Source: INRAM 2011

# Summary

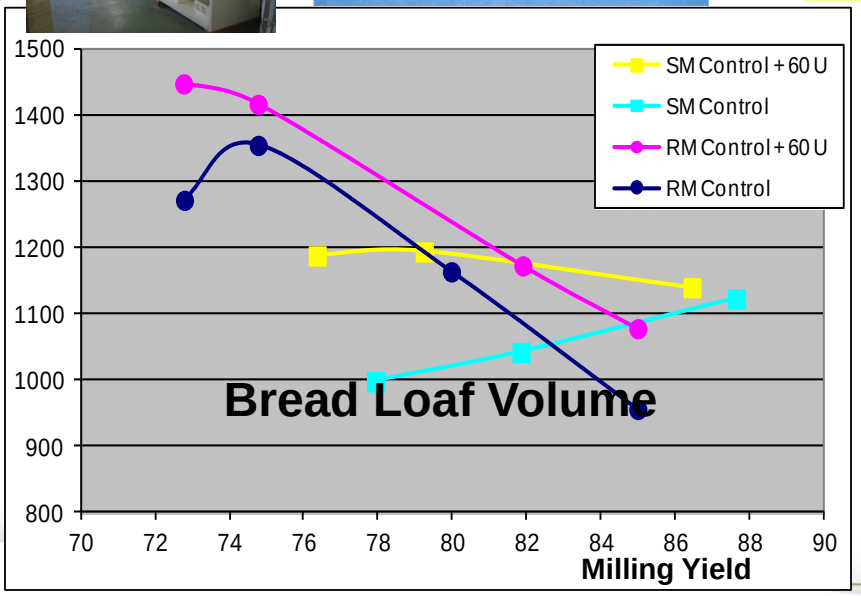
- ✓ Positive effect of N application on yield and grain protein level
- ✓ Intercropping systems and fertilization management could improved wheat performance and quality parameters ….. If weeds controlled, good soil fertility and no water limitation
- ➢ Green manuring an effective alternative to farmyard manure in grain systems

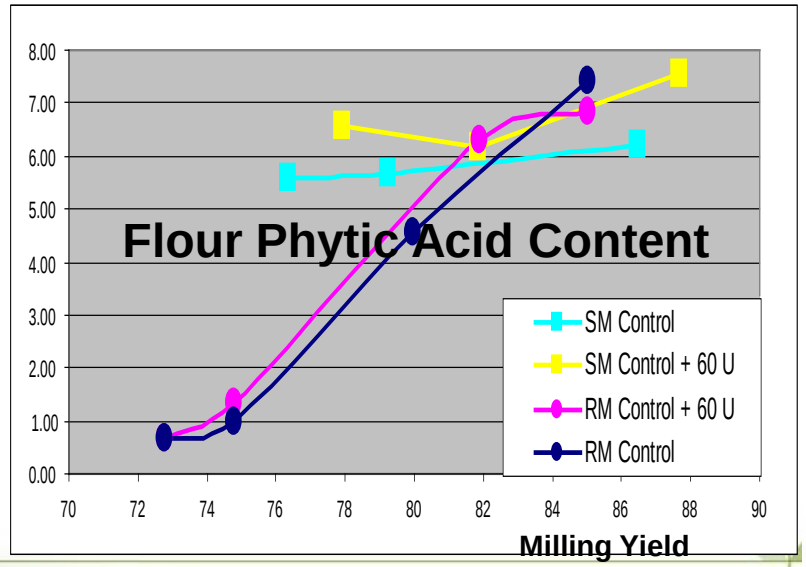
# Example 3. incidence of milling technology on baking performance and nutritive value

Stone milled *vs*
Rolled milled



- ✓ Flour with **stone milling (SM)** has **higher nutritive value than roller milling (RM)**
- ✓ **Stone milling** is less efficient to prevent potential **mycotoxin contamination**
- ✓ **Bread volume is lower with stone milling** and cannot be modulated by adjusting the milling yield
- ✓**Bread volume is variable with roller milling** sensitive to milling yield



# Summary

- ✓ Strong influence of milling technique and milling yield on baking properties and nutritive value

  Stone milling : nutritive value ☺ baking volume 😐

  ↗ Milling yield : nutritive value ☺ baking volume ☹

- ✓ Positive effect of pre-milling treatment (debranning and ozone) to prevent mycotoxin contamination

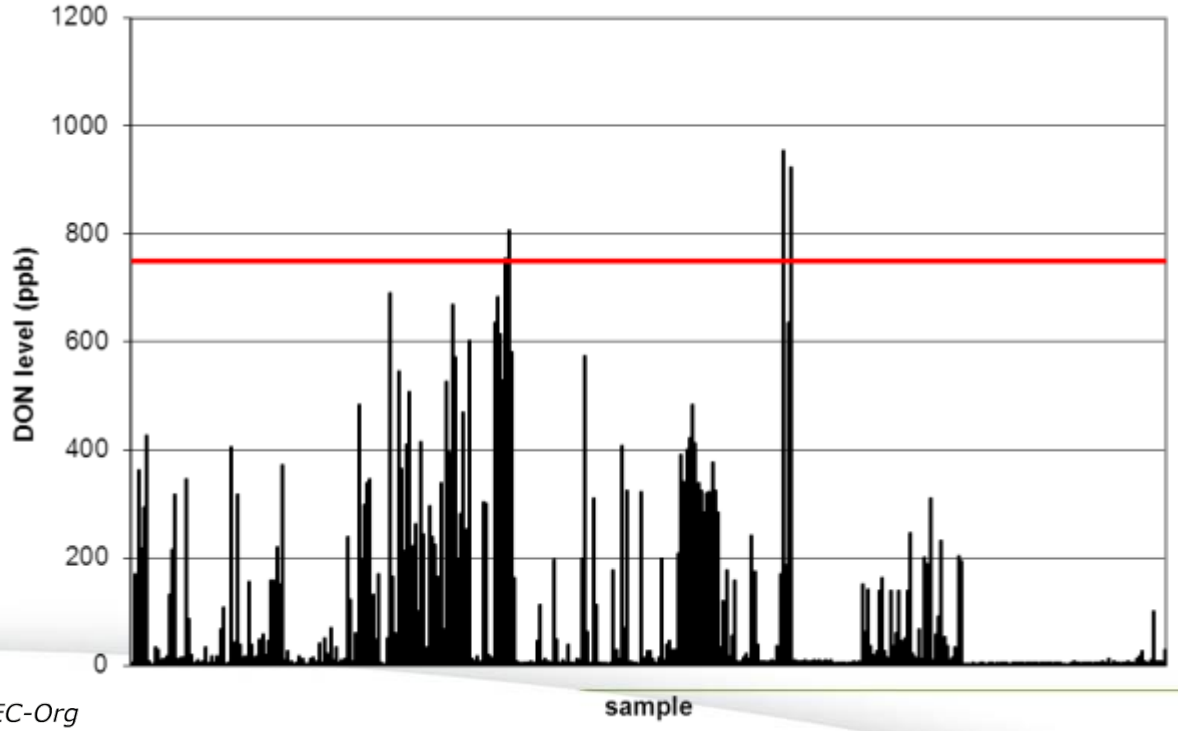
  Debranning : ↘DON ☺ baking value 😐

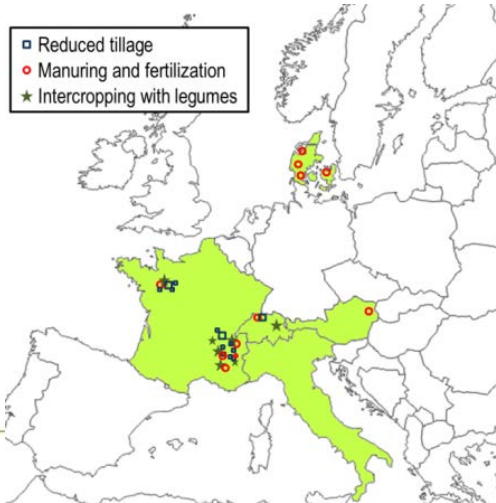
  Ozone treatment : ↘ DON ☺ baking value ☺

# Summary

✓ DON contamination **highly limited** in various organic conditions

More than 400 treatments were tested but only 3 presented level of DON contamination higher than 750ppb (less than 5% of them has DON levels higher than 500ppb)



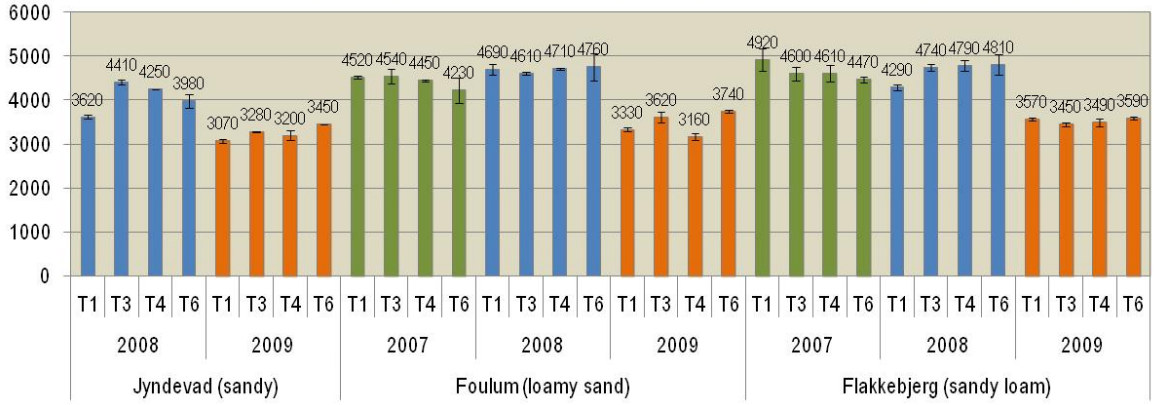

# Summary

- ✓ **Acceptable to good baking quality** although the protein content were variable and sometimes under the minimum threshold 10.5%



**AU CROPSYS as an example of baking results**

Loaf volume per kg of flour, 14 % m.b. ($cm^3$)



# Conclusion and Future

- ✓ Quality parameters are much less influenced by crop management (except cultivar) than grain yield
- ✓ Milling technology could improve baking properties and nutritive value
- ✓ Low risk of DON Contamination in organic conditions and efficient pre-milling treatment to limit contamination …
- ✓ Acceptable or good quality value even with low protein level and Zeleny index

## ➢ Future needs

1. Define others quality indexes to assess organic wheat-flour
2. Specify links protein composition – baking value in organic

# Communication and Dissemination


- **Leaflets** (3 in preparation) for farmers, advisers and millers ✓
- **National and international press** 4 popular papers ✓
- **Scientific publication** 16 papers published or in preparation ✓
- **Conferences** 12 papers in national an international conferences ✓
- **Msc (13) and Phd thesis (1)** ✓

# Thank you for your attention