



AGronomical and TEChnological methods to improve ORGanic wheat quality



David C, Celette F, Abecassis J, Aveline A, Carcea M, Chaurand M, Dubois D, Embolt S,

Friedel JK, Gunst L, Hellou G, Hiltbrunner J, Jeuffroy MH, Mäder P, Mayer J, Messmer M, Naudin C, Olesen JE,

Narducci V, Peigne J, Samson MF, Stolze M, Thommen A, Thomsen IK.

ISARA, France, ESA France; Agroscope Reckenholz Tänikon, Research Station (ART), Switzerland; Forschungsinstitut für Biologischen Landbau (FiBL), Switzerland; University of Natural Resources and Applied Life sciences (BOKU), Austria; Aarhus Universitet (AU) Denmark; Istituto Nazionale di Riserca per gli Alimenti e la Nutrizione Roma (INRAN), Italy and INRA Montpellier, INRA Grignon, France





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)

Baking properties

(INRAN, INRA)

Nutritional properties

(INRAN)

Mycotoxin contamination

(AU)

Post-harvest treatments

(INRA, INRAN, Goëmar)

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

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)

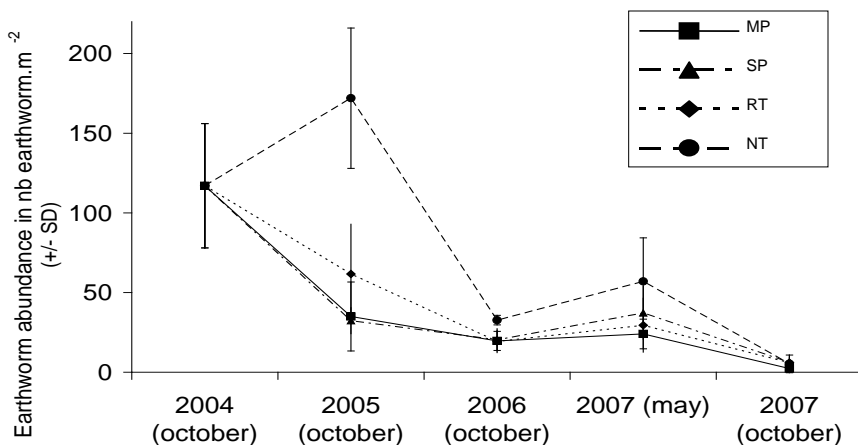
Three long term trials Started 2002 continued

Reduced tillage - shallow tillage at 5cm and occasionally at 15 cm

Plough – Traditional ploughing between 15 to 30cm depth

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



Source: FIBL, ISARA, ESA under publication

Example 2. Effect of legume intercrops on wheat performance



Three modes incorporating legumes in grain rotation have been compared

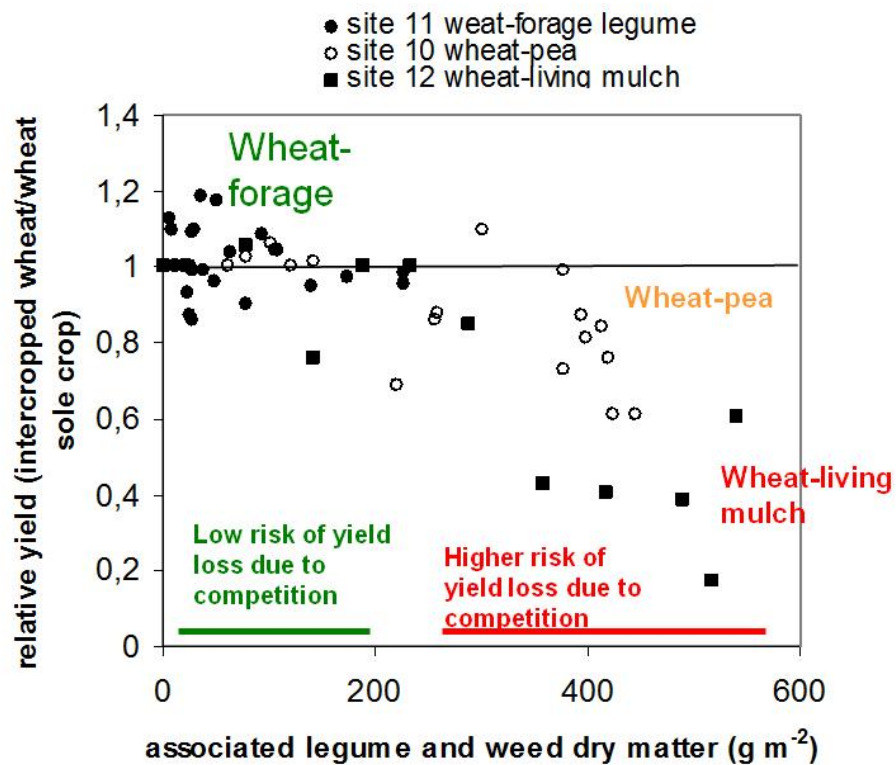
- Type 1. Wheat-Pea intercrops
- Type 2. Relay cropping with undersown forage legumes
- Type 3. Wheat sown in a living mulch of legume

Others treatments :

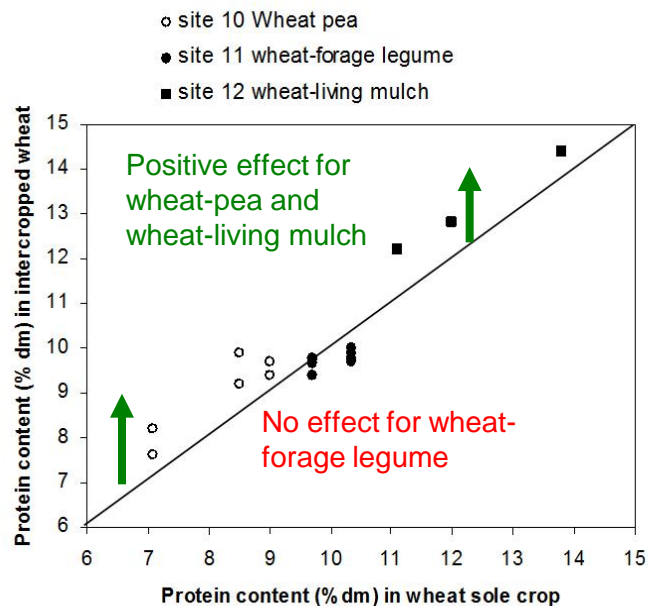
- Fertilization management additional N or no N
- Type of legume
- Wheat-Pea Ratio (30/70 – 50/50 – 70/30)

12 sites – 105 treatments

Example 2. Effect of legume intercrops on wheat performance



- ✓ Positive effect on the cumulative yield
LER = 1.3 for wheat-pea
- ✓ Competition on resources (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**

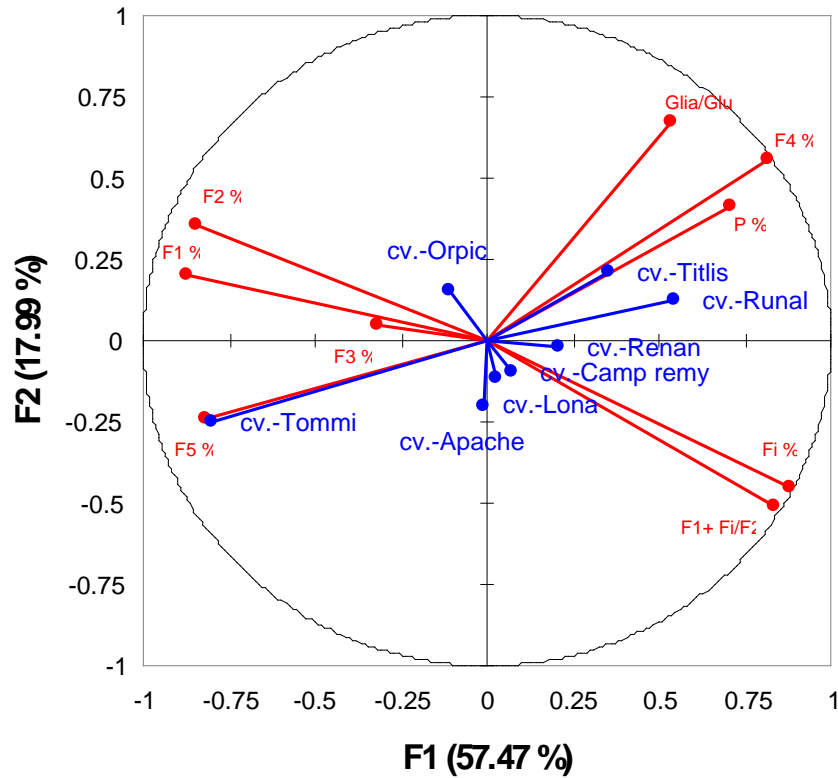


Source: Hellou et al. under publication



Research in Agronomy

Variables (axes F1 et F2 : 75.47 %)



Summary

- ✓ Strong influence of cultivar on yield and quality parameters

Summary

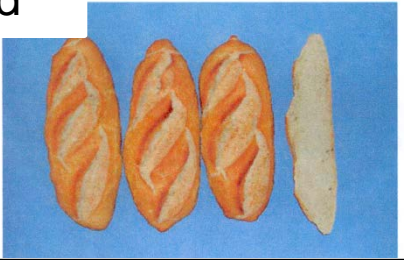
- ✓ Positive effect of N application on yield and grain protein level
- ✓ Intercropping systems and fertilization management could improved wheat performance and quality parameters If weeds controlled, good soil fertility and no water limitation
- Green manuring an effective alternative to farmyard manure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



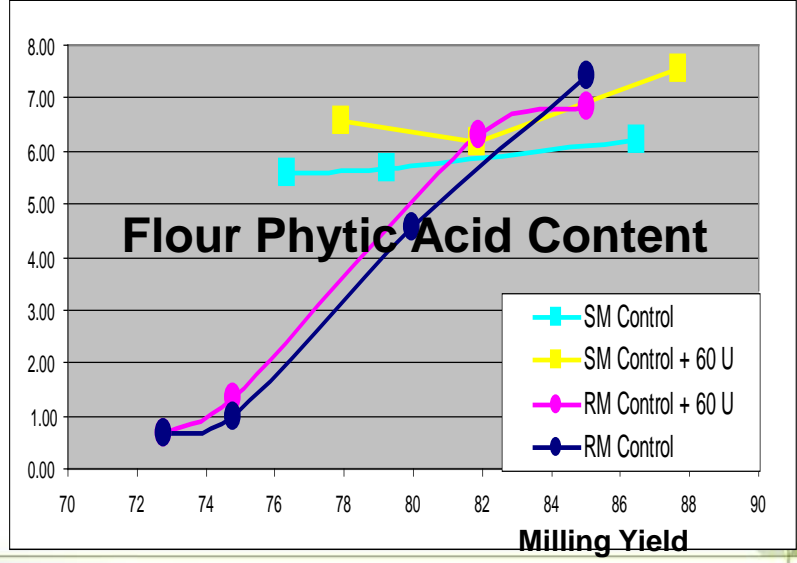
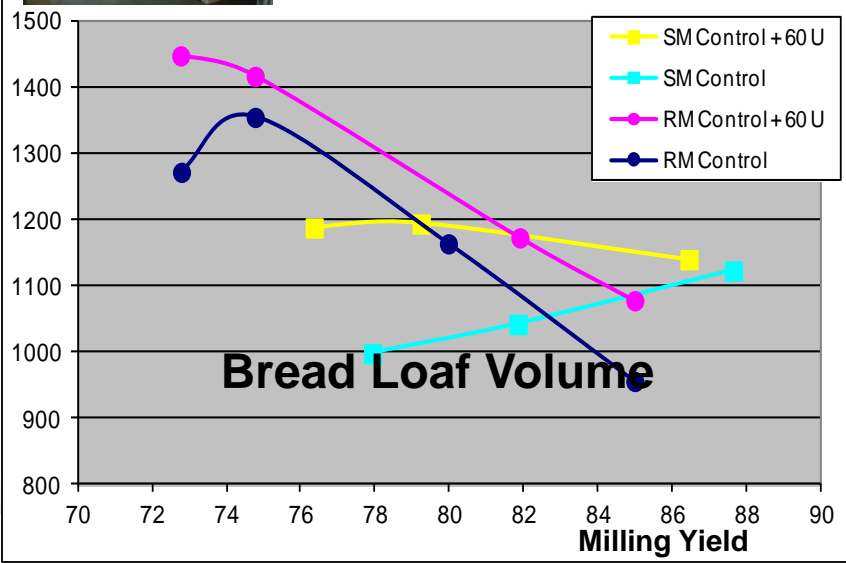
Example 3. incidence of milling technology on baking performance and nutritive value



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

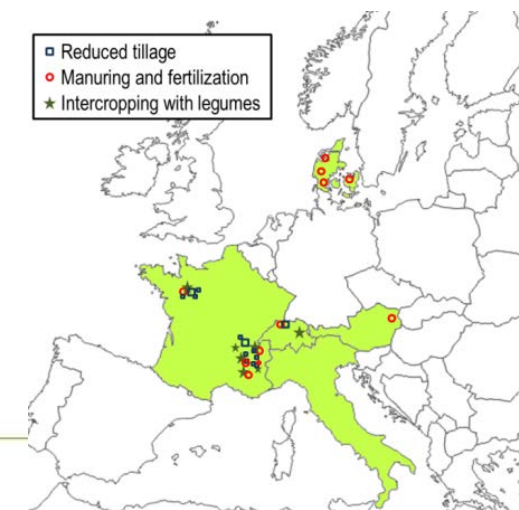
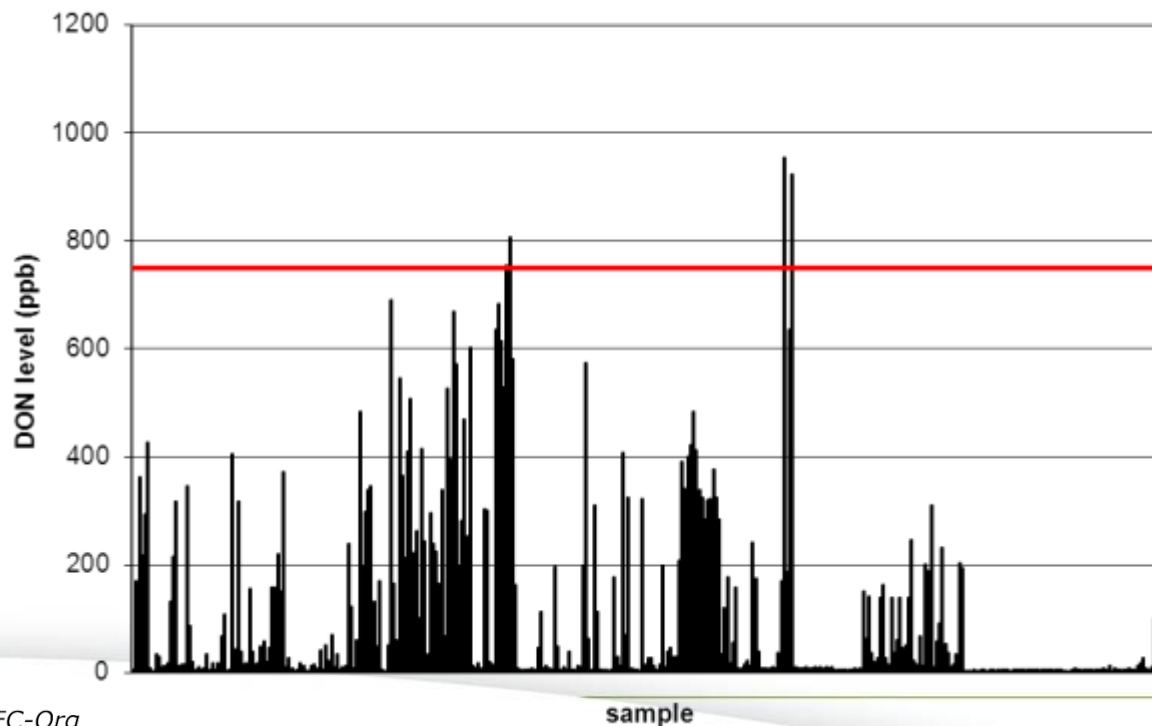
Debranning : ↓DON 😊 baking value 😞

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)





Research in wheat-flour quality

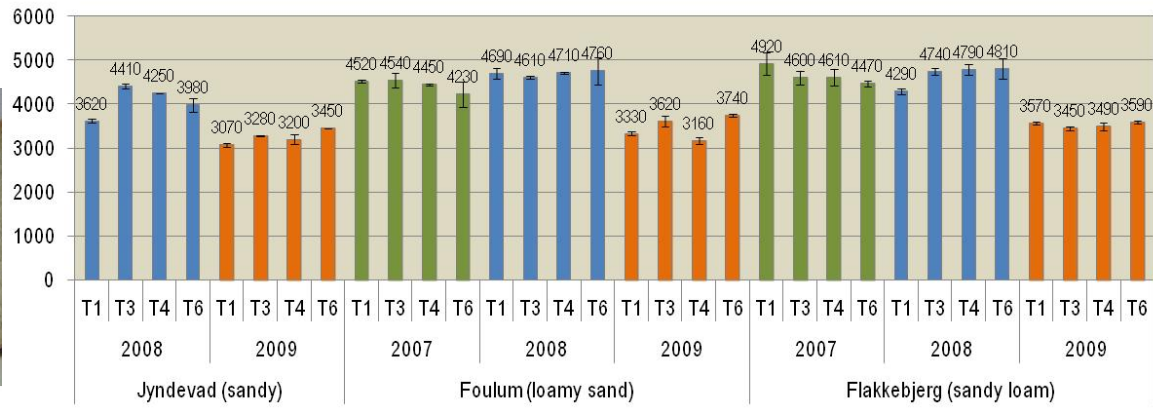
Summary

- ✓ **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. (cm³)



- ✓ 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



AGTEC-Org - **Ag**ronomical and **Tech**nological methods to improve **Org**anic wheat quality

A project of the research network **CORE organic**

Techniques to improve technological and sanitary quality

Summary

The demand for high quality organic cereals is increasing. In spite of the large lack of knowledge of consumers and producers' expectations, the quality of organic wheat was found to be generally low on tested grain samples. Choice of the wheat cultivar is the most efficient way to obtain higher grain quality. Fertilization with readily available nitrogen and to a lesser extent, association with mycorrhizal fungi and legumes can also improve grain quality. Reduced tillage affects soil quality and wheat yield but has little effects on grain quality.

Context and challenges of the AGTEC-Org project

During the last years the demand for organic bread cereals has increased in Europe (Mehlsien et al. 1999). For meeting the requirements in terms of grain quality, production is becoming increasingly important. However, consumer practices could be quite variable among European countries. There is a need of this production is realized in farms where cereals bread wheat production has to be developed. Most of this production is realized in farms where cereals bread wheat production has to be developed. Most of this production is realized in farms where cereals bread wheat production has to be developed.

Effect of long-term inputs of catch crops and cereal straw on grain composition and technological quality of a spring wheat

International Journal of Food Science and Technology 2011, 46, 216-220

Spalte Simonov¹, Marina Carcea² & Valentina Narducci¹

¹ Faculty of Agricultural Sciences, Aarhus University, PO Box 90, DK-8600 Tjele, Denmark

² Via D. Br. 21, 00178 Roma, Italy

Accepted for publication 22 September 2010

together with single protein (αS1, αI, 2, α*, γ-type gliadins, α- and γ-type high (HMW) and low (LMW) molecular weight subunits of glutelin) (Weser & Schweizer, 1998). The proteins can also be divided into 'big' proteins, and 'small' proteins. The 'big' proteins are gliadins and glutenins. The 'small' proteins are albumins and globulins. The 'big' proteins are gliadins and glutenins. The 'small' proteins are albumins and globulins.

Materials and methods

The wheat experiments took place on a light sandy loam (0/0/67) at Askov Experimental Station (55°52'N, 10°48' E) included four rotational treatments, initiated in 1981, and four rates of annual straw incorporation (0, 4, 8 and 12 t ha⁻¹ year⁻¹) combined with three crop strategies. From 2004, the three catch crop strategies were as catch crop, an annual catch crop + clover (Triticum spelta L.) catch crop and further details on the experimental design can be found in Thomsen (1995) and Thomsen & Christensen (2004). The plots assigned to winter wheat were ploughed on 17 September 2007 and winter wheat (cv. Trossi) sown

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 and international conferences

Msc (13) and Phd thesis (1)





Thank you for your attention

