FINAL REPORT (AUSTRIAN PROJECT PART)
Project no. ERAC-CT-2004-011716
ERA-NET CORE ORGANIC 1880

AGronomical and TEChnological methods to improve ORGanic wheat quality (AGTEC-Org)

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Endbericht

zur Vorlage an das Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft

Laufzeit des Projekts: 01.10.2007 – 30.06.2011
Projektleitung: Prof. Christophe David, ISARA-Lyon, Lyon Cedex 07
Leitung des österreichischen Projektteils: Dr. Jürgen K. Friedel, BOKU Wien

1. INTRODUCTION AND OBJECTIVES

The main challenge in the organic wheat production chain is to fulfil consumer expectations of providing healthy and safe products without impairing yield. The quality of organic grain can be modified by agronomic conditions such as crop management, crop rotation and soil fertility (Mäder et al. 2002). The post-harvest handling of grain and the flour processing are also key factors in producing bread of high nutritional value without contaminants. This project focuses on the optimization of agronomic practices and grain fractionation processes in order to obtain wheat and flour with improved nutritional value, health and sensory characteristics.

The general objective of the AGTEC-Org project is to identify agronomical and food technologies ways to improve baking quality and nutritional value of organic wheat and to avoid or reduce mycotoxin contamination.

Specific objectives

The overall objective of this project is to identify agronomical and food processing technologies that enhance the baking quality and the nutritional value of organic wheat and prevent or reduce mycotoxin contamination. Specific objectives are to:

• Evaluate the current practices for organic grain wheat production and flour-processing in Europe (David et al. 2011).

• Improve crop management strategies to enable bread-quality wheat to be produced on organic farms with and without livestock.

• Develop optimal post-harvest treatment to prevent or reduce mycotoxin contamination and enhance bread making quality and nutritional value.

• To generalise results from experiments in order to enhance farm management strategies in other climates and soil types.

2. PROJECT ORGANIZATION

WORK PACKAGE OVERVIEW

The project is organized in five work packages:

WP1 deals with the project management and the communication with stakeholders.

WP2 will manage the field experiments involving soil and N management regimes including N fertilization, by either establishment of high-N-fixing legumes as green manures or by intercropping.

WP3 will manage the post-harvest experiments to (1) enhance baking quality and nutritive value through optimal extraction using either roller or stone milling and (2) limit contaminants by physicochemical treatments.

WP4 will evaluate technological properties of grain and nutritive value and baking quality of flour and determine mycotoxin contamination of grain and flour.

WP5 will use modelling approaches to describe the different cropping systems, using the experimental results from WP2 to generalise results on yield and quality indicators for other climates, soil types and management strategies. An additional economical analysis will determine the financial viability of the different technologies, as used under various economical conditions in Europe.

THE AGTEC CONSORTIUM

Project partners and contact persons:

Partner no.	Organisation name:	Functions*):	Involved in WP's:	Contact person:
1	ISARA	PC WPM WPCM P P	 WP1 WP2 WP4 WP5	Christophe David
2	ESA	P WPCM P P	WP1 WP2 WP4 WP5	Anne Aveline
3	ART	P P P P	WP1 WP2 WP4 WP5	David Dubois
4	FiBL	P P P WPCM	WP1 WP2 WP4 WP5	Paul Mäder
5	**BOKU**	P P P P	WP1 WP2 WP4 WP5	Jürgen K. Friedel
6	Aarhus University	P WPCM WPCM P	WP1 WP2 WP4 WP5	Ingrid Thomsen
7	INRAN	P WPCM P	WP1 WP4 WP5	Marina Carcea
8	INRA-Montpellier	P WPM WPCM	WP1 WP3 WP4	Joël Abecassis
9	INRA-Paris-Grignon	P WPCM	WP1 WP5	Marie-Hélène Jeuffroy

*) PC: Project Coordinator, WPM: Workpackage Manager, WPCM: Workpackage Co-manager, P: Participant

3. WORK PACKAGE DESCRIPTION AND PROGRESS OF WORK

Only the work packages with BOKU contribution are addressed.

WORK PACKAGE 1:

Project meetings

The first project meeting on the AGTEC-Org project group took place in Lyon on October 24 – 25, 2007. This first meeting was centred on methodological aspects to establish a common methodology for the agronomical experiments (WP2) and technological analysis (WPs 3 and 4). Two technical handbooks were produced to fix the common methodology. Then, all partners described the activities planned in year 1. During year 1, field experiments (WP2) and measurements of quality parameters on these experiments (WP3) had been achieved. Hence, meetings between the coordinator and partners were held to precise the contents of each WP (including WP 4 and 5 planned for year 2 and 3) and to define the consortium agreement. The meeting of the coordinator with BOKU took place after the CORE Organic kick off meeting in Vienna in September 2007. Also during the Organic World Congress (OWC) if the ISOFAR in Modena, Italy, in June 2008 experiments and technological tests were discussed.

The second meeting, held at ART, Zürich, in early October 2008, was centred on results from WP2 and WP3. The objective was to reinforce cooperation within each WP and facilitate cross-analysis between agronomist and technologist. The results were discussed and some publications were planned. The third meeting took place at INRA, Montpellier, in October 2009. It was focused on publications and dissemination of the project. In October 2010 a phone conference was held. The progress in each work package, publication of articles and coordination of the final report were discussed. A final working meeting in France is planned for June 2011.

Project communication and administration

- The consortium members have extensively exchanged information and data through e-mailing sent to the group where methodology was discussed and common documents were produced.

- BOKU agreed on and signed the consortium agreement in late November 2008.

- The consortium produced a leaflet in English to present aims and deliverables of the AGTEC-Org. This one is available on http://www.coreorganic.org/research/foldere.pdf/agtec.pdf

- The coordinator developed the web-site http://www.coreorganic.org/research/foldere_pdf/agtec.pdf to communicate about project results and events.

Organic Wheat and Flour survey

In Austria, as in the other countries of the project consortium, experts, key persons of organic grain trading, millers, and stakeholders were interviewed and literature was reviewed to obtain data on the wheat and flour production chain. Basis for the interviews was a common questionnaire developed among the partners. Interesting data on organic wheat production and farming systems were provided. On the contrary, little information was collected on economic data of wheat-flour chain. For this part of the survey, some data for the Austrian situation are available at the Austrian Agency for Organic Grain ("*Österreichische Agentur für Bio Getreide GmbH*") (www.agentur-fuer-bio-getreide.com) * but they are not publicly available.

* At time of report generation the Austrian Agency for Organic grain has already become insolvent. State: 09.2011

WORK PACKAGE 2.2: FIELD EXPERIMENTS: NITROGEN FERTILISATION AND GREEN MANURE

The effects of farmyard manure and/or green manure on winter wheat performance and quality are assessed under five long-term field experiments: CROPSYST and Askov in Denmark, MUBIL in Austria, and DOK and FRICK in Switzerland. In the MUBIL experiment (site 8) in Eastern Austria, a long-term trial established in 2003 (Surböck et al. 2006), effects of different organic manure systems within a crop rotation system on soil properties and crop performance and quality are assessed. The soil is a Calcaric Phaeozem with 33 % clay and 0.16 % total nitrogen in the Ap horizon. The 8-year crop rotation is Lucerne – Lucerne – Winter wheat 1 – Root crop or Maize – Cereal – Peas – Winter wheat 2 – Cereal.

The effects on winter wheat (*Triticum aestivum*, cv. Capo) of lucerne removal for fodder use and its replacement with farmyard manure (FM) equivalent to approx. 170 kg N ha^{-1} $(4\ yr)^{-1}$ (Tables 2 and 3), simulating a livestock keeping system (0.5 livestock units ha^{-1}), have been compared to the effects of two stockless systems with either only lucerne green manure (GM) or lucerne green manure plus communal compost (GMCO). In total, six treatments have been studied in both 2008 and 2009 as a consequence of 1) three different organic manure systems (GM, GMCO, and FM) and 2) two positions of winter wheat in the crop rotation ("Wheat 1" following lucerne in the 3rd year and "Wheat 2" following peas in the 7th year). Farmyard manure and communal compost were applied only to Wheat 2 following peas because the precrop effect of lucerne on Wheat 1 was assumed to be sufficient also without additional fertilization input (Table 4). So in FM compared to GM treatment, for Wheat 1 (no green manuring) a reduced and for Wheat 2 an enhanced (FM addition) fertilisation system effect can be expected. Due to modification of the crop rotation plan during conversion to organic farming, winter wheat was only grown following lucerne (Wheat 1), not following peas (Wheat 2) in 2007. For this experimental year, only yield characteristics but no protein quality criteria were assessed.

Table 1: Description of the trial

	Site 8
Location	Austria, Rutzendorf 48.2° N - 16.6° E
Soil	33 % clay
Norg (%)	0.16
Climate	Continental
Annual rainfall (mm)	544
Mean temperature (°C)	10.5
Year with wheat	2008 and 2009
Cultivar and charge	In both experimental years, original seed of the cultivar *Capo* was obtained from a uniform grain delivery. Control numbers: 2008: A8M1253/1, 2009: A9M1501/1
Factors	1. Type of manure (GM, GMCO, FM) 2. Position of wheat in crop rotation (8-field crop rotation, 2x wheat, see text)
Treatments	GM1 (Wheat 1, Green manure) GMCO1 (Wheat 1, Green manure + Communal compost) FM1 (Wheat 1, Farmyard manure) GM2 (Wheat 2, Green manure) GMCO2 (Wheat 2, Green manure + Communal compost) FM2 (Wheat 2, Farmyard manure)

Fertiliser- and N-level

Table 2: Fertilisation management of winter wheat 2008

Year	PC	TM	fertiliser	N	P_2O_5	P	K_2O	K	Organic matter	C
			kg ha^{-1}							
2008	**P**	**GMCO**	**23000**	**163**	86	37	133	110	4789	2754
2008	**P**	**FM**	**18220**	**163**	114	50	476	395	4780	2251

Legend: PC=Pre crop, P=pea, TM=treatment, GMCO=green manure + communal compost, FM=farmyard manure

Table 3: Fertilisation management of winter wheat 2009

Year	PC	TM	fertiliser	N	P_2O_5	P	K_2O	K	Organic matter	C
			kg ha^{-1}							
2009	**P**	**GMCO**	**26000**	**187**	78	34	138	114	6919	3666
2009	**P**	**FM**	**18220**	**171**	86	37	261	216	3134	1663

Legend: See table 2

Distribution of organic fertilisers

Table 4: General crop rotation and manuring

Crop rotation	TM	Lucerne	Lucerne	Winter wheat	Maize	Spring barley	Pea	Winter wheat	Winter rye
Org. fertiliser	GM	Mulching	Mulching		–			–	
	GMCO	Mulching	Mulching		Compost			Compost	
	FM	Removal	Removal		Farmy.m.			Farmy.m.	

Legend: TM=treatment, GM=green manure, GMCO=green manure + communal compost, FM=farmyard manure, Farmy.m.=farmyard manure

Methodology of quality parameters

Quality parameters were determined according to ICC Standard. For more detailed information see Thomsen, et.al., submitted 2011.

Statistical analysis

In MUBIL, the data were analyzed based on a split plot design with pre-crop as a main factor and fertilization as a minor factor in SPSS software (SPSS 16.0). A general linear model was used, where year (Y), pre-crop i.e. position in the crop rotation (PC) and fertilization treatment (FT) were considered as fixed factors, while replication (Rep) was considered as random factor. Original data were log-transformed if requirements for homogeneity of variance were not fulfilled.

Results

Wheat development was generally better in 2008 than in 2009 as indicated by plant height, crop yield and protein contents (Table 5). This year effect was significant for most of the studied traits (Table 6). The

effect of the three fertilization treatments (GM, GMCO, FM), however, was not significant. For plant height, crop yield, crude protein, nitrogen yield, dry Glutein and Zeleny Index, the interaction of treatment and precrop (TR*PC) was statistically significant (Table 6). This shows contrary fertilization system effects on Wheat 1 and Wheat 2 in the crop rotation.
Crop yield data of wheat 2 after pre-crop pea showed higher values for the treatments GMCO and FM. This results from the supply of external nitrogen due to fertilization with communal compost and farmyard manure compared to no external nitrogen supply in the GM treatment. Crop yield of wheat 1 after pre-crop lucerne was higher in the GM and GMCO treatments, as lucerne green manure remained on the field and lead to higher nitrogen supply compared to the FM treatment where lucerne was removed from the field (Figure 1). This trend of higher values in the treatments GMCO and FM after pre-crop pea and higher values in the treatments GM and GMCO after pre-crop lucerne in both experimental years was also observed for some other traits, as described below.

Table 5: Results of the main studied traits (mean values of replications per treatment)

Year	PC	Treatment	PH	CY	FN	CPR	NY	Moi	Ash	DryGlu	Zeleny	DON
			[cm]	[t/ha at 86% DM]	[s]	[% DM]	[kg/ha]	[%]	[% DM]	[% DM]	[ml]	[ppb]
2008	**L**	**GM1**	101.46	6.21	341.25	13.85	129.63	11.62	1.52	9.82	44.17	20.94
2008	**L**	**GMCO1**	102.29	6.00	352.00	13.75	124.18	11.63	1.50	10.13	42.33	16.37
2008	**L**	**FM1**	99.79	6.09	374.50	12.65	116.18	11.54	1.53	7.45	37.00	9.61
2008	**P**	**GM2**	96.88	6.16	305.75	14.13	131.66	11.91	1.47	11.50	51.83	19.91
2008	**P**	**GMCO2**	98.75	6.47	291.50	14.23	139.00	11.80	1.47	11.09	43.17	43.81
2008	**P**	**FM2**	101.46	6.62	289.75	14.30	142.83	12.04	1.48	11.66	46.50	69.89
2009	**L**	**GM1**	85.71	4.68	454.50	13.64	96.30	11.63	1.78	10.25	43.67	3.22
2009	**L**	**GMCO1**	86.58	4.90	415.50	13.61	100.67	11.57	1.72	11.40	44.67	6.09
2009	**L**	**FM1**	84.42	3.92	431.25	13.53	79.77	11.03	1.77	11.06	44.33	64.16
2009	**P**	**GM2**	98.83	5.59	391.75	11.31	95.36	11.23	1.79	9.39	30.33	1.47
2009	**P**	**GMCO2**	99.58	5.86	382.00	11.28	99.70	11.43	1.70	8.36	32.00	0.99
2009	**P**	**FM2**	104.00	5.73	418.00	12.02	104.24	11.30	1.76	9.61	37.33	3.04

Legend: PC=pre crop, L=lucerne, P=pea, DM=dry matter, PH=plant height, CY=crop yield, FN=falling number, CPR=crude protein, NY=nitrogen yield, Moi=moisture, Ash= ash content, DryGlu=dry Glutein, Zeleny= Zeleny Index, DON=deoxynivalenol content, ppb=$\mu g\ kg^{-1}$

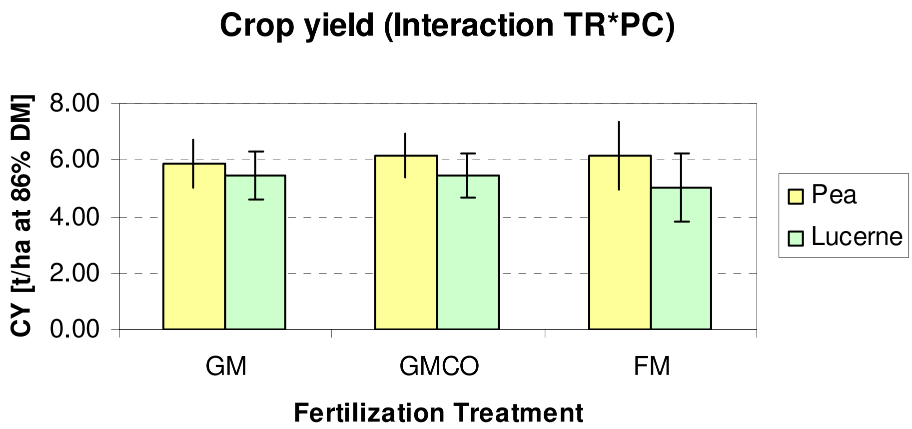
Table 6: Significance levels for the factor effects and their interactions for the main studied traits

Effect	PH	CY ♦	FN	CPR	NY	Moi	Ash	DryGlu	Zeleny
PC	.000 *	.000*	.000*	.008*	.004*	.403	.204	.557	.007*
Year	.000*	.000*	.000*	.000*	.000*	.018*	.000*	.541	.000*
PC*Year	.000*	.002*	.181	.000*	.288	.157	.370	.002*	.000*
Rep (PC*Year)	.323	.295	.295	.007*	.319	.110	.677	.057	.887
TR	.242	.150	.141	.690	.350	.460	.146	.589	.334
TR*PC	.006*	.027*	.991	.001*	.004*	.150	.976	.012*	.042*
TR*Year	.876	.023*	.456	.006*	.682	.205	.372	.057	.004*
TR*PC*Year	.933	.197	.039*	.592	.553	.564	.857	.169	.365

Legend: PC=pre crop, Rep=replication, TR=Fertilization treatment. For other abbrevations see legend of Table2.

The significance level $P < 0.05$ is indicated with *, log-transformed data are indicated with ♦.

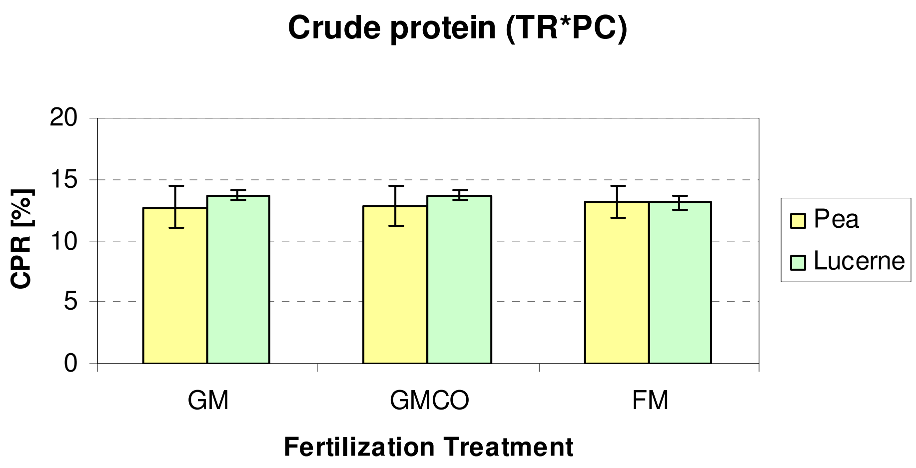
Winter wheat after pea showed higher plant height than winter wheat after lucerne in each fertilization treatment. Values ranged from 97.9 (GM), 99.2 (GMCO) to 102.7 (FM) cm after precrop pea and 93.6 (GM), 94.4 (GMCO) to 92.1 (FM) cm after precrop lucerne. Reduced plant height of wheat after lucerne can presumably be related to a higher water consumption of lucerne that reduced water availability and nitrogen mineralisation in the soil. This tendency in plant development was also cognizable for crop yield (Table 5) and may also have contributed to higher protein contents of wheat after lucerne compared to wheat after pea (Figure 2).



Legend : GM= green manure, GMCO= green manure + communal compost, FM= farmyard manure, PC= pre-crop, TR= fertilization treatment; bars indicate one standard deviation

Figure 1: Average grain yield of winter wheat following two different pre-crops in three fertilization treatments

As expected, the FM treatment to winter wheat after peas increased crude protein contents (Figure 2). Values hardly differed between the three fertilization treatments for winter wheat after lucerne (13,7% at GM and GMCO, 13,1% at FM) (Figure 2). Crude protein contents of wheat after lucerne were higher compared to those of wheat after pea in 2009, in line with an increased N delivery of lucerne compared to pea. In 2008, unexpectedly the opposite effect was found (Table 5 and PC*Year interaction in Table 6). An explanation for this can be found in the specific cropping history of winter wheat (2008) after pea (2007). The precrops were wheat in 2005 and Triticale in 2006, both with low crop yield because of drought in case of wheat and a yellow dwarf virus infection in case of Triticale. Because of this low crop yield nitrogen uptake was reduced, which resulted in a high N supply for winter wheat in 2008 and thus high protein contents.



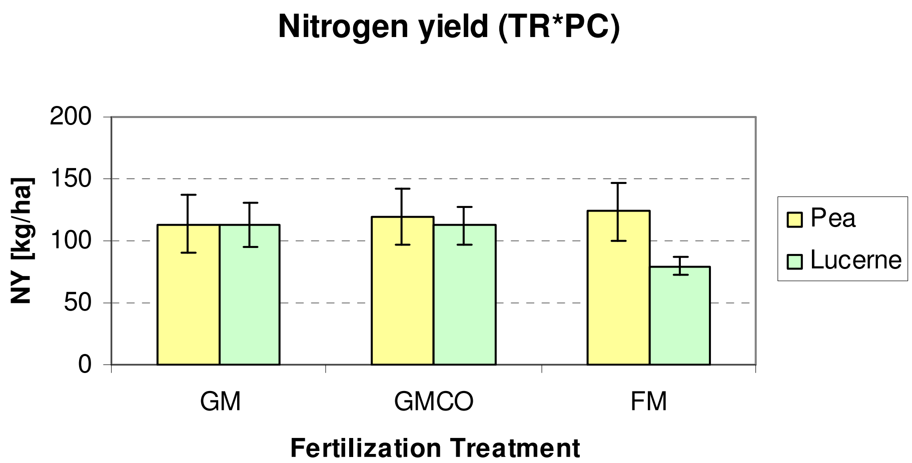
Legend see Figure 1

Figure 2: Average crude protein content of winter wheat following two different pre-crops in three fertilization treatments

Crop yield and crude protein content determine nitrogen yield. The precrop * fertilization treatment interaction of increased values in the GMCO and FM treatments of wheat after peas versus decreased values in FM treatment of wheat after lucerne (Figure 3) is very similar to the crop yield data. Also the Zeleny index for baking quality was largely following this pattern (Figure 4).

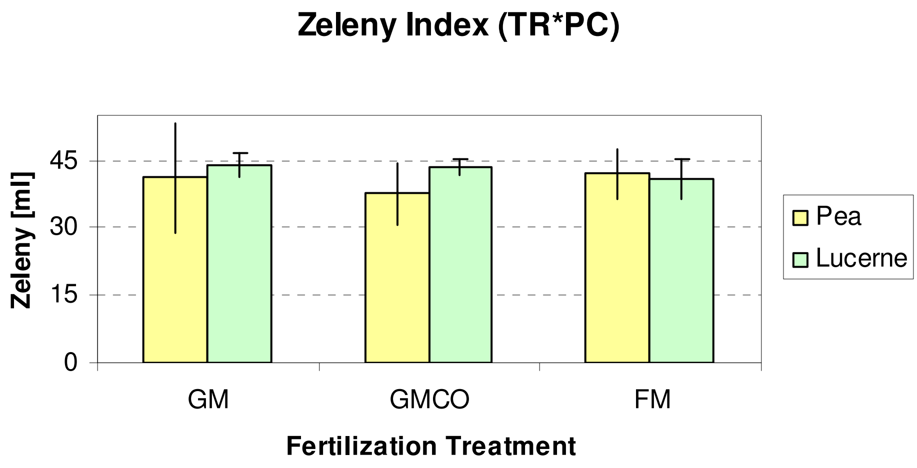
DON contents were far below the permitted level of 750 µg kg^{-1}. Most values did not even reach the detection limit of 18.5 µg kg^{-1} (Table 5). Therefore no statistics were applied to the DON results.

In general, wheat productivity and quality did not differ much between the farmyard manuring (livestock keeping) system and the (stockless) mulching systems. Variability of crop yield between wheat 1 after lucerne and wheat 2 after peas was less in the green manuring systems than in the farmyard system. Variability in protein contents between the two wheat crops, however, was slightly less in the farmyard system. This may be advantageous in some cases like in 2009 when only wheat after peas in the farmyard manuring system surpassed the threshold value for food wheat in Austria of 12 % crude protein content (Table 5).



Legend see Figure 1

Figure 3: Average nitrogen yield of winter wheat following two different pre-crops in three fertilization treatments



Legend see Figure 1
Figure 4: Average Zeleny Index of winter wheat following two different pre-crops in three fertilization treatments

Conclusions

• Viewed over the 2-years trial period, values for crop yield and quality parameters were generally high. Even though mainly pre-crop lucerne is expected to increase crop yield and crude protein, this experiment showed that pre-crop pea positively influenced these parameters as well due to the specific cropping history during the experimental period.

• The high water consumption of lucerne presumably reduced water availability to the following wheat, thus limiting crop growth and yield (Tables 4 and 5).

• The two manuring systems green manuring (GM) and farmyard manuring (FM) showed the supposed opposite effects on wheat yield and quality of the two wheat crops in the rotation. This was reflected by a significant pre-crop – treatment interaction for the majority of the traits. The overall effect of the two systems on wheat yield and quality, however, did not differ, as indicated by a non-significant treatment effect (Table 6). A longer experimental period would be required to reveal or exclude minor treatment effects.

• Farmyard manuring may influence quality parameters like crude protein. For example, the FM2 treatment (12.02% for wheat following pea) fulfilled the 12% level for wheat for milling purpose, while GM2 (11.31%) and GMCO2 (11.28%) remained below this limit. (Table 5: Winter wheat after pea 2009)

• Green manuring (GM and GMCO treatments) may positively influence crop yield and crude protein contents of the following wheat crop because of increased nitrogen availability (Table 5: winter wheat after lucerne 2009).

WORK PACKAGE 4: GRAIN AND FLOUR QUALITY

Grains collected in the MUBIL field experiment from fertilisation plots and, depending on the DON content of the samples, also from the field scale (WP 2.2) were provided for different pre- and post-treatments and milling techniques (WP3). Analyses of hardness, ash content, total protein, dietary fibre, bound hydrophilic antioxidants and some specific physico-chemical parameters for proteins such as Zeleny sedimentation index and gluten index and flour rheological properties (farinograph, alveograph, extensibility test, sedimentation test) were performed by INRAN and INRA Montpellier. (For results see international final report of the project)

WORK PACKAGE 5: SCENARIO ANALYSES AND SYNTHESIS

Based on the data provided by BOKU and other partners in the organic wheat survey in WP1, a typical crop rotation and crop management for organic wheat growers will be constructed by INRA Grignon using two crop growth models. This work started in 2009.

An economic simulation model will be developed by FIBL analysing the economic impacts of the innovations for typical quality-wheat producing farms in all partner countries. This work will base on the wheat survey realised in the project (WP1). During the 3rd project meeting, the economic results explored in WP2 and WP3 were evaluated for 10 typical farms producing quality wheat in the partner countries. The economic simulation model will simulate the financial effects for varying levels of yields, costs and prices and will provide information about the sensitivity and robustness of the results. Furthermore, the limitations and constrains for on-farm implementation will be identified.

4. REFERENCES

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5. APPENDICES

Appendix 1.

Organic cereal and flour survey (Austria)

1 st Questionnaire: Organic grains farming systems in Europe:

Characterization of the organic grains production:

-Historical evolution of Organic production:

Total wheat surface [ha]

year	1997	1998	1999	2000	2001	2002
wheat	4872	5550	5674	6832	7428	9826

year	2003	2004	2005	2006	2007	2008
wheat (W)	12771	17305	21453	22079	22852	22680
durum wheat (DW)	114	162	99	112	131	139
W+DW [ha]	12885	17467	21552	22191	22983	22819

Source: Agrar Markt Austria (AMA), www.ama.at, state: 06.06.08

Number of farms

year	2000	2001	2002	2003	2004	2005	2006	2007
Number of organic farms	19028	18292	18576	19056	19826	20310	20162	19997
Therefrom data collected by INVEKOS •	18645	17773	18191	18760	19577	20104	19986	19829

Source: calculations of the federal institute for agricultural economy, cited INVEKOS, data provided by DI Otto Hofer (member of the Austrian Ministry for life, department 11/5b, www.lebensministerium.at): otto.hofer@lebensministerium.at phone: +431711006753 state: 01.07.08

Cereal production [t]:

year	2005	2006	2007
W	80404	72372	80754
DW	229	465	513
W+DW	80633	72837	81267

Source: INVEKOS, data provided by DI Otto Hofer (member of the Austrian Ministry for life, department 11/5b, www.lebensministerium.at): otto.hofer@lebensministerium.at phone: +431711006753 state: 01.07.08

• INVEKOS = Integriertes Verwaltungs- und Kontrollsystem (integrated administration and controlling system), based on the decree (EEC=European Economic Community) no: 3508/93. It is used for handling and controlling of aiding activities of the EU.

Exported and imported amounts, [t] (data only available for Austrian farming systems in general (conventional + organic))

	year	01/02	02/03	03/04	04/05	05/06	06/07
W	Production	1462162	1384753	1127551	1630234	1390369	1319692
	Import	209652	236233	160171	251287	305931	393933
	Export	672811	657504	433292	723797	696422	585105
DW	Production	46121	49455	63829	88590	62704	76609
	Import	72345	60141	64624	93995	103005	72677
	Export	50172	40704	55147	96765	91926	76776
W+DW	Production	1508283	1434208	1191380	1718824	1453073	1396301
	Import	281997	296374	224795	345282	133598	466610
	Export	722983	47693208	483439	820562	788348	661881

Source: Statistik Austria, www.statistik.at state : 06.08

Structure of organic farming systems according to INVEKOS

Organic farming systems in total	
Number of farms with collected data	19829
Total surface [ha]	371251
Average surface/ farm [ha]	18.9

Organic grain systems	
Number of organic grain systems	7050
Total cereals surface	76418
Average cereals surface/ farm [ha]	10.8

Source: INVEKOS, data provided by DI Otto Hofer (member of the Austrian Ministry for life, department 11/5b, www.lebensministerium.at): otto.hofer@lebensministerium.at phone: +431711006753 state: 01.07.08

Export and import:
main destinations:

Export (bread grain 50%): Germany, Switzerland
Import (feedgrain 30-40%): Italy, Czech Republic, Hungary

Source: Interview with Thomas Rogy, former manager of the Austrian agency for Organic grain.
State: 02.08
www.agentur-fuer-bio-getreide.com
Österreichische Agentur für Bio Getreide GmbH / Hauptstraße 17 / A-3820 Raabs/Thaya

-Main Organic productions:

Total surface [ha]

	Total cereals	Wheat	Root crops	Grain legumes	Oil crops
Total surface [ha]	76481	25393	3197	11773	6303

Source: INVEKOS, data provided by DI Otto Hofer (member of the Austrian Ministry for life, department 11/5b, www.lebensministerium.at): otto.hofer@lebensministerium.at phone: +431711006753 state: 01.07.08

Legend:

Total cereals = wheat, barley, rye, oat, spelt, maize, Triticale, others
Wheat = winter wheat, spring wheat, durum wheat
Root crops = potatoes, sugar beet, fodder beet
Grain legumes = pea, field bean, lupine, lentils, sweet pea, others
Oil crops= rape, sunflower, soya, pumpkin, flax, poppy seed, others

Number of farms:

	Organic farming systems with cereals	Organic farming systems with grain legumes	Organic farming systems with oil crops	Organic farming systems with potatoes
Number of farms	7050	2276	1323	2934

Source: INVEKOS; cited Grüner Bericht 2007, www.gruener-bericht.at

Total production amount [t]:

	Total cereals	Wheat	Oil crops(soya)	Root crops (Table potatoes)	Grain legumes
Total production amount [t]	*Breadstuff:* 123425 *Foddergrain:* 71105 *Total:* 194530	*Wheat:* 80754 *Durum wheat*: 513 *Total:* 81267	3139	45797	*Pea:* 7448 *Field bean:*1653 *Total:* 9101

Source: INVEKOS, data provided by DI Otto Hofer (member of the Austrian Ministry for life, department 11/5b, www.lebensministerium.at): otto.hofer@lebensministerium.at phone: +431711006753 state: 01.07.08

Main trade outlets and market share (rank from 1 to 3)

	Total cereals	Wheat	Root crops	Grain legumes	Oil crops
Human nutrition	2	2	1	2	1
Animal Feeding	1	1	2	1	2
Others	3	3	3	3	3

Source: Interview with Thomas Rogy, former manager of the Austrian agency for Organic grain. State: 02.08
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Characterization of the main farming systems:

-Farming systems:

Farming systems: Three examples representing Austria

Farming System	**(1)**	**(2)**	**(3)**
Name of the farming system	Arable farm without animal husbandry	Arable farm with predominantly breeding sows or with predominantly dairy cows	Predominantly grassland with dairy cows
Site	Marchfeld- North-eastern lowland and downs	Downs of eastern Styria- South-eastern lowland and downs	Mostviertel (South of Eisenwurzen)- Pre-alps
Climatic conditions	Semiarid to weakly semiarid- *average rainfall*: 450-550 mm *average annual temperature*: 8 – 10 °C	Weakly humid- *average rainfall*: 700-1000 mm *average annual temperature*: 7.5 – 9.5 °C	Strong to moderate humid- *average rainfall*: 1200-2000 mm *average annual temperature:* 4 – 8 °C
Soil conditions	Profound to shallow black earth soil, very suitable for farmland	Arable land on cliffy, hot, moderate humid sites with lowland forest and marsh area in the bottom of the valley	Sandy loam, clay [∞]
Average surface area / farm [ha]	60	6.5	8
Main preceding crops to wheat	Lucerne or pea	Clover grass or field bean	Clover grass
Livestock density [LU/ha]	-	1.2 (breeding sows) 2.4 (dairy cows)	0.92

Sources:

Regina Hrbek, Bernhard Freyer, Jürgen K. Friedel (2005):Nachhaltige Fruchtfolgesysteme und Düngekonzepte für den Energiepflanzenanbau zur Biogasproduktion. Division of Organic Farming,
University of Natural Resources and Applied Life Sciences, Vienna

Thomas Rinnofner, Bernhard Freyer, Jürgen K. Friedel (2008): Nachhaltige Fruchtfolgesysteme für den Energiepflanzenanbau. Division of Organic Farming,
University of Natural Resources and Applied Life Sciences, Vienna

[∞] source: gis.lebensministerium.at/eBOD

Typical crop rotation:

Farming system (1): stockless organic farm

Year	**Crop**	**Percentage of crop in crop rotation [%]**
1	Lucerne	12.5
2	Lucerne	12.5
3	Winter wheat	12.5
4	Potato Sugar beet	9.0 3.5
5	Winter rye	12.5
6	Pea	12.5
7	Winter wheat	12.5
8	Spring barley	12.5

Source:
Thomas Rinnofner, Bernhard Freyer, Jürgen K. Friedel (2008): Nachhaltige Fruchtfolgesysteme für den Energiepflanzenanbau. Division of Organic Farming,
University of Natural Resources and Applied Life Sciences, Vienna

Farming system (2): organic farm keeping breeding sows

Year	**Crop**	**Percentage of crop in crop rotation [%]**
1	Field bean	20
2	Winter Wheat	20
3	Maize	20
4	Spelt	20
5	Triticale	20

Source:
Thomas Rinnofner, Bernhard Freyer, Jürgen K. Friedel (2008): Nachhaltige Fruchtfolgesysteme für den Energiepflanzenanbau. Division of Organic Farming,
University of Natural Resources and Applied Life Sciences, Vienna

Farming system (2): organic farm keeping dairy cows

Year	**Crop**	**Percentage of crop in crop rotation [%]**
1	Clover grass	16.7
2	Clover grass	16.7
3	Winter wheat	16.7
4	Maize	16.7
5	Spring barley	16.7
6	Spelt	16.7

Source:
Thomas Rinnofner, Bernhard Freyer, Jürgen K. Friedel (2008): Nachhaltige Fruchtfolgesysteme für den Energiepflanzenanbau. Division of Organic Farming,
University of Natural Resources and Applied Life Sciences, Vienna

Farming system (3): organic farm keeping dairy cows

Year	Crop	Percentage of crop in crop rotation [%]
1	Clover grass	20
2	Clover grass	20
3	Winter wheat Triticale	10 10
4	Triticale	20
5	Spring barley	20

Source:
Regina Hrbek, Bernhard Freyer, Jürgen K. Friedel (2005):Nachhaltige Fruchtfolgesysteme und Düngekonzepte für den Energiepflanzenanbau zur Biogasproduktion. Division of Organic Farming,
University of Natural Resources and Applied Life Sciences, Vienna

-Typical technical management for wheat management:

Concerning this part of the survey only few data, valid for Austrian Organic farming systems in general, are available.

Soil tillage management:
Usage of plough as well as no till management. Ploughing is prevailing.

Fertilization:
Unusual for farms without animal husbandry because of the nitrogen input by legumes in preceding crops.

Farms with animal husbandry apply mainly liquid manure in spring.

Weed management:
It is done mainly mechanically.

Pest management:
Regulated by crop rotation systems; no direct pest management.

Source: Interview with Franz Waldenberger, product manager at Bio-Austria
franz.waldenberger@bio-austria.at ; www.bio-austria.at ; state: 17.07.08

2 nd Questionnaire: Characterisation of the Organic wheat and flour production organization:

For this part of the survey, some data are available at the Austrian agency for Organic grain but they are not publicly available.

Source: Interview with Josef Strommer, member of the Austrian agency for Organic grain
www.agentur-fuer-bio-getreide.com
Österreichische Agentur für Bio Getreide GmbH / Hauptstraße 17 / A-3820 Raabs/Thaya; state: 17.07.08

Quality criterions for conventional and organic wheat in Austria:

Conventional wheat:

	Wheat for milling purpose	Quality wheat	Premium wheat
Hectoliter weight [kg]	79	80	80
Falling number [sec]	220	250	280
Protein content [%]	12.5	14	15

A financial bonus for higher quality is not usual, except for individual agreements.

Source:
Börse für landwirtschaftliche Produkte; www.boersewien.at; state:10.08

Organic wheat for milling:

In Austria quality criterions for wheat are not state-determined any more. Each tradesman respectively mill has the opportunity to make particular demands on farmers. So there is a certain bandwidth in demands, even though it is not very high.

	Minimum	Base value	Favorable value
Hectoliter weight [kg]	75	78	High values are advantageous.
Falling number [sec]	220	A base value does not exist for falling number	250-320
Protein content [%]	12 (most common)	A base value does not exist for protein content	High values are advantageous (dependent on payment scheme).

Different classes of protein content [%]:

Since harvest 2001, there is a differentiation in price for different classes of protein content.

Model 1:

	Protein content [%]
Organic fodder wheat	< 11.0
Organic (food) wheat	11.0-11.9
Organic food wheat	12.0-12.9
Organic food wheat	13.0

Model 1 is the most advantageous one for farmers but it was hard to accomplish it in recent years. For harvest 2009 for example it was extensively theorie.

Model 2:

	Protein content [%]
Organic fodder wheat	< 12.0
Organic food wheat	12.0-12.9
Organic food wheat	13.0-13.9
Organic food wheat	14.0

Model 3:

	Protein content [%]
Organic fodder wheat	< 12.0
Organic food wheat	12.0-12.9
Organic food wheat	13.0-13.4
Organic food wheat	13.5

Model 2 as well as model 3 are most praxis-relevant.

Source:
Interview with Michael Oberforster, michael.oberforster@ages.at
AGES (Österreichische Agentur für Gesundheit und Ernährungssicherheit GmbH; www.ages.at)
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