APPLICATION TO THE COREORGANIC PILOT CALL

RISKS AND RECOMMENDATIONS REGARDING HUMAN PATHOGENS IN ORGANIC VEGETABLE PRODUCTION CHAINS - "PATHORGANIC"

23 April 2007 (revised)

1. State of the Art

A continuous rise in the number of outbreaks of human diseases associated with the consumption of vegetables has been documented during the last few decades (6, 27). Apart from the steady increase in the consumption of uncooked and minimally processed vegetables, the sources of contamination in the environment are themselves increasing (6, 30). There is evidence that the increased use of untreated animal manure for fertilization constitutes an elevated risk of contamination with human pathogens. The food safety issue seems to apply particularly to organically grown produce. Cornerstones in organic production are sustainability and recycling of nutrients and therefore animal manure is used more frequently to maintain soil fertility than in conventional production. On the other hand, higher microbial diversity in organic soils may be suppressive to introduced pathogens (8).

Plant produce-linked outbreaks of human diseases have been associated also with viruses and parasites but most cases involve bacterial faecal contamination. The largest reported vegetable-borne outbreak to date occurred in Japan in 1996 and was caused by *E.coli* O157:H7, affecting more than 11,000 people (21). In 2006, a spinach-linked outbreak caused by the same pathogen was reported in the U.S. (22). Other bacterial pathogens of concern include *Salmonella enterica*, which has been isolated from many types of vegetables (e.g. 13, 29), *Campylobacter* spp., which are frequently found in the farming environment (e.g. 14), *Listeria monocytogenes*, which is a common saprophyte on plants (3), and *Staphylococcus aureus*, which has been detected in plant produce (18; Sessitsch et al., in prep.). Due to the increasing occurrence of strains that are resistant against commonly used antibiotics, and as enteric pathogens are more likely to multiply in cut and pre-packaged plant produce, which is becoming more popular with consumers, the number of incidents may significantly increase in the next decades.

From a European perspective, the prevalence of food-borne pathogens on vegetables and their involvement in outbreaks are not well documented. Furthermore, safety guidelines are missing which define measures to be taken and criteria to be obtained for minimizing contamination (27). This means that the routes of pathogen introduction into plant produce need to be elucidated with regard to current cultivation practices.

The level and survival of human bacterial pathogens in manure depends on the type of animal, animal diet, stress and age (16, 25) as well as on manure management and mode of application (9, 15). Increasing the delay between the application of manure and harvest has proven effective for reducing the number of pathogens in plant produce (17, 24). Cattle diet and soil management (12) as well as the seasonal conditions following manure application (23) have been found to affect the rate of decline in pathogens in soil. However, human pathogens are able to survive in the rhizosphere, since this compartment is known as a reservoir of human pathogens (2). Following root colonization, some pathogens are able to spread endophytically from the root to the shoot where they become a source of infection (19; Sessitsch et al, in prep.). Conclusive guidelines on the management and safe usage of manures for plant fertilization still have to be established. In several countries (e.g. DK) guidelines for the use of manure are very conservative, and in order to improve plant production there is a need to identify less restrictive application modes that do not compromise food safety.

To assess the risks related to the persistence of food borne pathogens on or inside plant products, where they interact with the resident plant microflora, knowledge of the colonization performance of various pathogens is required. Colonization is dependent on plant characteristics, which partly rely on the plant genotype (8) and fitness, as well as on traits of the pathogenic bacterial strain itself (1). In addition, our understanding of how environmental conditions and processing practices (cutting, washing, storage, transport, packaging and display) influence the fate of pathogens (28) is incomplete. Therefore, studies on the prevalence of various food-borne pathogens in/on organically grown plant produce as affected by various cultivation and processing conditions are needed.

Since in conventional and organic farming most chemical treatments for pathogen control are not allowed, the suppression of pathogens has to rely primarily on the impact of the natural microflora and on external environmental parameters. Generally, plant pathogens seem to be better suppressed in organically versus conventionally managed soils thanks to the more diverse and active microflora and fauna (31, 32). However, it is still unclear how human pathogens are influenced by the common microbial colonizers of plants and soils. While antagonistic bacteria have been identified which were suppressive to the growth and survival of human pathogens on plants (7, 20), other competitors tested increased their growth (20). Temperature was found to be critical for the competitiveness of invading pathogens relative to the resident microorganisms (5). To better understand colonization of human pathogens in organic farming systems, the complex relationships in the soil-plant-microbial-system need further exploration.

To improve the safety of vegetable products regarding contamination with human pathogens, reducing risk factors during production and handling has been implicated as the most efficient strategy. Some steps within the concept of Hazard Analysis by Critical Control Points (HACCP) can be adopted for identifying risks along vegetable production chains, as has been shown previously in the EU project “Organic HACCP” (Organic HACCP; QLK1-CT-2002-02245; 33). However, a quantitative microbial risk assessment for organic horticultural products has not been performed so far (11). The proposed project aims at assessing qualitatively and quantitatively the risks of introducing human pathogens into organically grown plant produce under the influence of various environmental and management conditions. Based on risk analysis recommendations for improving food safety in organic production will be formulated, which will be then disseminated through a technical leaflet for farmers. The project webpage and a final workshop shall serve as a communication platform among interested stakeholders.

2. Objectives of the Project

PathOrganic addresses the **quality and safety of organically produced vegetables throughout the production chain**. The main concern is the contamination with enteric bacterial pathogens. The project will improve our understanding of how various factors (e.g. environment, plant genotype, fertilizer application technique, soil buffering etc.) affect pathogen spread and persistence and will enable to better **control plant produce-associated human pathogens.**

In order to carry out a meaningful survey and to choose appropriate experimental plans, we first will build a **model** for pathogen transfer to selected plants to describe relevant food chains. Based on this model **sampling strategies** and **methodological adjustments** will be made. Moreover, a questionnaire will be set up to describe current management practices along selected food chains (WP1). WP2 of the project is dedicated to **surveying the presence of food pathogens** in organic plant produce. As a major part of the project, field surveys of organic farming systems will be performed and plant products will be sampled in five European countries. The analysis of relevant parameters will be done by partners with the appropriate expertise. “Risk crops” and “risk factors” shall be identified and entire production chains shall be investigated, leading to the **determination of critical control** points (CCPs). Factors suggesting a problem concerning food safety will be subjected to more detailed analysis in WP3 by performing specifically targeted greenhouse and field experiments. These experiments will allow to **analyze critical environmental and management factors** and at the same time will enable to re-assess the critical control points. Finally, based on the results obtained in the previous WPs, in WP4 we will provide **recommendations** for improving procedures which secure consumer-oriented food safety and the quality of certified organic vegetable food chains.

3. The Consortium

Universities and research centres from five European countries will work closely as partners for PathOrganic. A minor, non-experimental component will be sub-contracted. Each partner has been selected carefully based on his/her expertise to fulfil the objectives of the project. The consortium is characterized by a highly complementary expertise, and each partner will have a distinct role in this project. This is required for the multi-disciplinary approach chosen for this project encompassing outstanding expertise in i) **organic farming systems** (FiBL, PRI-WAU**, ACW, ART, BOKU, DFVF); ii) **food safety aspects** in (organic) plant production (PRI-WAU**, FiBL, GSF, ARC, ACW, RVAU); iii) biological risk assessment of **animal manure and slurries** (DFVF); iv) molecular and conventional **detection methods of pathogens** (SLU, GSF, ACW, ART, ARC, DFVF, RVAU), v) identification of **critical control points** (FiBL, PRI-WAU**), and vi) design and set-up of **greenhouse/growth chamber and field experiments** to study microbial ecology and plant-microbe interactions (ACW, ART, GSF, SLU, ARC, BOKU, FiBL).

** sub-contract

Short name	Institute full name	Principal scientist	Country
ARC/ BOKU	Austrian Research Centers GmbH / Univ. of Natural Resources and Applied Life Sciences, Vienna	A. Sessitsch / J. Friedel	A
GSF	National Research Center for Environment and Health	M. Schmid / A. Hartmann	D
FIBL/ ACW/ ART	Research Inst. of Organic Farming / Agroscope Changins-Wädenswil/ Agroscope Reckenholz-Tänikon	G. Wyss / P. Mäder / B. Duffy / F. Widmer	CH
SLU	Swedish University of Agricultural Sciences	J. Jansson	SE
DFVF/ RVAU	Danish Inst. of Food and Veterinary Research / Royal Veterinary and Agricultural University	D. Baggesen / A. Dalsgaard	DK
PRI-WAU	Plant Research International / Wageningen University (as minor sub-contract)	C. Zijlstra / A. van Bruggen	NL

4. Work package description and milestones

WP1. Current practice and harmonization of methods (months 1-16)
Participating partners: ARC*, FiBL, ART, SLU, GSF, DFVF, RVAU, PRI-WAU**
* responsible partner/s **sub-contract

The principle aim of WP 1 is to build a model for pathogen transfer to selected risk plants based on the investigation of current practices of manure-derived fertilizer application in organic plant production (DFVF/RVAU, PRI-WAU). The model will be based on work already performed at the Wageningen University. The existing model will be extended by taking into account additional, relevant risks.
In addition, WP 1 is aimed at adapting existing molecular methods for the detection of bacterial pathogens in plant produce, soil, water, compost and manure with sufficient sensitivity, specificity and speed (ARC, ART, GSF, SLU). Here, standard faecal indicator analyses for *E. coli* and other enteropathogens will be used, because these indicators usually are present in high numbers in animal manure in contrast to pathogens, which if present are likely to occur only in low numbers. In addition, specific pathogenic strains will be quantified by using molecular techniques. Because of their high-throughput potential highly sensitive, molecular detection methods will be selected for successive large-scale screenings (to be performed in WP 2). Protocols will be refined for application in complex matrices such as soil, manure and compost. Questionnaires will be set up and evaluated (FiBL) to determine the relevant food chains and management practises to be investigated in the subsequent surveys (WP2). In addition, appropriate common-standard sampling procedures and survey protocols will be developed for the use by all partners (FiBL, SLU, GSF, PRI-WAU). First, small scale distribution studies will be performed to investigate which parts of the plants (monitored in WP2) get infested. Based on this information large scale distribution sampling protocols will be developed, taking into account differences among e.g. type of product and geographical distribution and that a low prevalence of human pathogens is to be expected in final products. Models, sampling plans and protocols will be harmonized among all partners in well planned project meetings.

The following **tasks** are addressed in **WP 1: i)** extension of a model describing routes of pathogen transfer; **ii)** optimization of pathogen detection methods; **iii)** exploration of food-production chains by the use of questionnaires; **iv)** development of survey protocols.

The **milestones** will be: **i)** extended model for pathogen transfer through use of manure-based fertilizer (month 6) **ii)** methods adapted for the detection of pathogens (month 10); **iii)** protocols established for sampling procedures and surveys (month 11); **iv)** description of food chains through evaluation of questionnaires (month 16).

WP2. Surveys of food-borne pathogens (months 12-28)
Participating partners: ACW*, ARC, BOKU, FiBL, ART, SLU, GSF, DFVF, RVAU
* responsible partner

The aim of WP 2 is to ascertain the highest–risk vegetable commodities in organic production chains and to identify potential exacerbating factors. Incidence and levels of enteric pathogens (pathogenic *E. coli*, various serovars of *S. enterica*, *L. monocytogenes*, *C. jejeuni*, and *S. aureus*) will be determined in a wide range of vegetables from the full diversity of organic production systems. Furthermore, the prevalence of pathogens in diverse amendments (e.g. manure, compost, slurry) used in these organic production systems will be assessed to pin-point potential sources of contamination.

In phase I, organic vegetables which are likely to be fertilized with animal waste and which are usually eaten uncooked will be selected for baseline analyses. In five countries, organic vegetables from stores and plants from organic production fields will be sampled (BOKU, GSF, FiBL, SLU, DFVF). Pathogen contamination will be monitored with both PCR-based and conventional plating methods (see WP1) (ACW, SLU, GSF, ARC). Critical pathotypes will be distinguished from innocuous enteric bacteria.

Based on the results from WP1 and WP2 (phase I), production types, geographical areas and plants posing an elevated risk will be identified. In addition, the "gap in knowledge" for performing a microbial risk assessment (MRA) in organic plant production will be identified and the necessary phase II research activities will be outlined. In phase II, the actual risks for consumers will be thoroughly analyzed by including the whole line of production and processing of such "risk crops". For example, if spinach that has been grown with animal waste used as fertilizer shows contamination with enteric pathogens at harvest, then the entire production chain will be investigated. Spinach may actually be at increased risk after containment in plastic bags due to the growth of bacteria. If elevated concentrations of target bacteria are found in a given crop derived from all organic systems, then we will need to examine the specific problem factor associated with organic production as such. If a problem can be attributed to a few outlier farms, then we can focus on specific features of these farms for further study in WP3.

WP 2 comprises the following **tasks**: **i)** literature study; **ii)** survey of organic plant produce at markets and in the field; **iii)** identification of critical control points in the entire production and food chains; **iv)** determination of information gaps in relation to MRA.

The **milestones** will be: **i**) assessing which data are available or lacking for performing MRA (month 14); **ii)** identifying high-risk crops and production systems (month 16); **iii)** description of food chains and listing of critical control points in the production chains (month 28).

WP3. Mechanistic description of food contamination with human pathogens (months 12-34)
Participating partners: SLU*, ARC, GSF, BOKU, ACW, FiBL, ART, DFVF
* responsible partner

The aim of WP3 is to study those management factors in detail which potentially lead to the contamination of organic plant produce with human pathogens. Factors which in WP2 have been implied to be problematic will be subjected to more detailed analysis so that risk mitigation strategies may be developed.

In phase I, interactions between microbial strains representing major food pathogens and various plant cultivars (e.g. cultivars of lettuce, spinach and carrots) used in organic farming will be studied in detail, because different plant species and genotypes usually interact very specifically with microorganisms (ARC, GSF). Research will address pathogen transfer and survival in association with multiple modes of usage of animal-derived fertilizers that are disposable for organic plant production, considering application techniques, timing within the plant growth period and environmental factors (RVAU).

Greenhouse/growth chamber/phytotron experiments will be carried out at several participating laboratories using soils from various European long-term organic field experiments in different geographic regions (ARC/BOKU, SLU, GSF, ART, FIBL). Soils which have experienced long-term organic farming may be expected to be high in microbial biomass and/or diversity, which may result in enhanced competitiveness and suppression of "invading" pathogens (biological buffering). The persistence in soil and plant uptake of human pathogens which have been applied to manure in different concentrations will be studied in detail.

Based on the information from WPs 1 to 3 a quantitative microbiological risk assessment will be performed, in which the key parameters affecting pathogen occurrence and survival after application of manure-based fertilizers in organic plant production will be identified. Standard procedures and methodologies for MRA, i.e. simulation models, will be used. Evaluation of mitigation strategies will be included and the scientific background will be given for formulating practical guidelines for safe organic production (DFVF/RVAU).

In phase II the empirical data from WP2 will be confirmed and further analyzed in greenhouse/ growth chambers and field experiments (FiBL/ART/ACW, SLU). For example, if a potential risk of contamination has been attributed to spinach in the surveys and it persists at the end of the production chain when consumers buy it, then WP3 will examine the risk factors (e.g. cultivar, fertilization procedure, post-harvest storage). In case WP2 indicates swine manure as a problem factor relative to other manures, then in WP3 controlled field experiments with different manure types and differently processed manures will be conducted. In parallel, controlled greenhouse/ growth chamber experiments will be performed to test the same factors by using inoculation with BL-2-pathogens. Different representative European climatic and other environmental conditions will be considered.

WP3 is divided into the following **tasks**: **i)** testing the effect of plant genotype on pathogen colonization; **ii)** testing the effect of the management of manure-based fertilizers on pathogen contamination; **iii)** testing the effect of biological buffering on pathogen persistence; **iv)** running MRA models and formulating risk mitigation strategies; **v)** confirmation of risk factors identified in WP2.

The **milestones** will be to **i)** identify susceptible plant species and genotypes (month 16); **ii)** produce additional and necessary data for MRA (month 24); **iii)** determine the effect of biological buffering on pathogen persistence (month 28); **iv)** identify risk factors in experimental trials (month 34).-

WP4. Final Risk Assessment, Communication and Recommendations (months 18-36)

Participating partners: FiBL*, ACW, ARC, BOKU, ART, SLU, GSF, DFVF, RVAU, PRI-WAU**

* responsible partner ** sub-contract

The overall aim of WP4 is to summarize all findings referring to critical control points and potential risks along the vegetable production chains (WP 2 and 3) and to elaborate specific recommendations. This will also be achieved by adjusting a model for risk assessment of human pathogen spread and persistence especially on lettuce in collaboration with project participants and stakeholders. This expertise will serve at formulating the risk model and discussing the identified risks and recommendations with the aim to ensure the relevance of the project for organic plant production.

Experimental results from PathOrganic will be combined with expert knowledge from project participants and stakeholders in order to adapt the existing quantitative microbial risk assessment model for the contamination of a model risk plant such as lettuce with enteric bacteria. This model will be made with the spreadsheet-based probabilistic program "@Risk" (DFVF, PRI-WAU**). Sensitivity analysis will reveal which parts of the production chain have the most pronounced effect on the final risk. Theoretical intervention strategies can be tested with respect to the effect on the final risk of contamination. Results from the questionnaire will help to finalize the critical points along the selected chains and to validate the risks identified by the model.

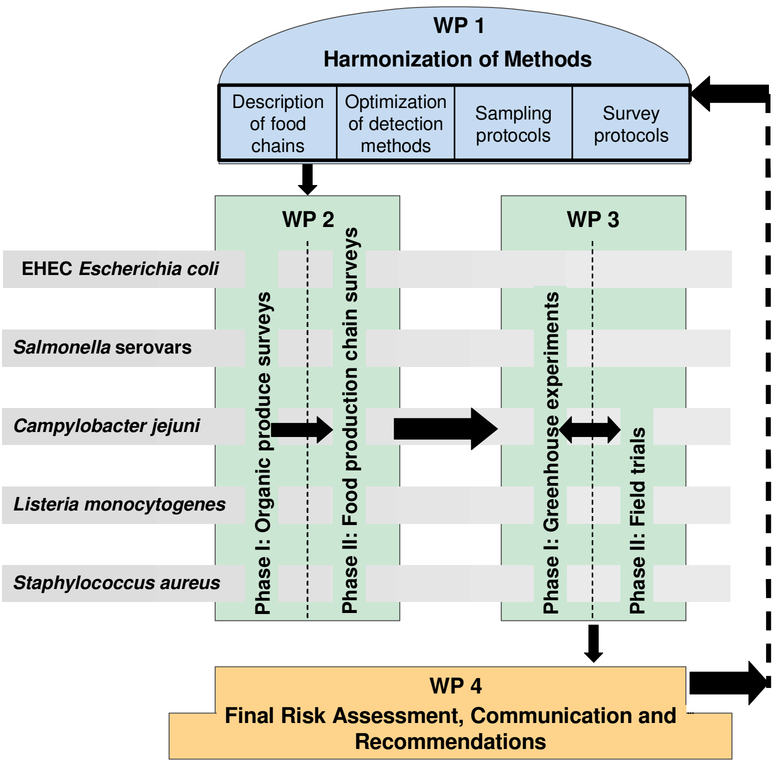
A final workshop (within the last six months) with organic producers, European organic producer organizations, marketing chain representatives and politicians will be held to discuss the critical control points and recommendations and to check the suitability of the proposed risk model. Contacts with stakeholders will also ensure that the results of the research will be communicated to interested parties.

WP4 encompasses the following **tasks**:

i) adaptation of an existing model based on "@Risk" for contamination of a model risk plant with enteric pathogens serving for the final microbiological risk assessment;
ii) summarizing all the risks identified based on quantitative (model) and qualitative (question-naire) assumptions as well as on experimental findings;
iii) communication of results to end-users, the EU and national governments.

The **milestones** will be

i) formulating recommendations for a realistic risk model for various pathogens in risk plants (month 18),
ii) an actual risk assessment model based on the program "@Risk" (month 24),
iii) recommendations for improved farm management procedures (month 30),
iv) a workshop to evaluate the risk model and discuss the critical control points and recommendations (month 33),
v) non-scientific and scientific publications for end-users (e.g. consumers and science) (month 33),



Overview of the PathOrganic work programme

vi) reporting to the EU and national programs (month 36).

5. Ecological, Social and Economic Relevance

PathOrganic strives to better control microbe-mediated contamination of organically grown plant produce, and thereby supports organic production and sustainable agriculture. **Ecological benefits** thereof include the warranty of food safety together with reduction of environmental damage caused by energy-demanding mineral fertilizers and pesticides and the commitment to landscape-protection. The project is of **social relevance** by addressing consumers' concerns about the quality and health-impact of food prepared from fresh plant produce. Dissemination activities consider the public demand for information about risks and benefits related to consumption habits. Social impact is also given by offering jobs and training to young scientists (e.g. Ph.D. students involved in PathOrganic) by promoting mobility and by taking gender issues seriously into consideration. PathOrganic is of **economic relevance** because it aims at expanding the market for organically grown plant produce. Organic producers and food processing companies benefit economically from recommendations derived from project results and the introduction of HACCP-based protocols, which minimize costly risks of bacterial contaminations.

6. Dissemination Plan

Dissemination activities within PathOrganic include i) The construction of a **project webpage** presenting objectives and results as well as links to participating and relevant organizations; ii) The establishment of a **technical leaflet for farmers** with the aim to promote awareness of risks and benefits related to the organic production of fresh plant produce; iii) Partners in PathOrganic will **publish** their results in high-ranking scientific journals; iv) A **workshop** will be organized which serves as a communication platform between scientists, organic plant growers, food processing companies, and politicians. This will facilitate the formulation of potential risks and recommendations for improved procedures based on the requirements of producers and at the same time novel detection and surveillance technologies shall be presented; v) PathOrganic partners will present results at national **agricultural schools** and **universities** as well as at international scientific **conferences**.

7. Project Management

The main applicant will take over the coordination and overall management of the project and will take care that the project tasks are carried out in a timely manner. The **coordinator** together with the **work package leaders** will form the **project management team**, which will be responsible for the financial and executive management as well as for dissemination and promotion activities. **Meetings** will be arranged regularly twice per year, in which the work progress will be reported and details on the execution of the planned work will be discussed. Deviations from planned activities will be made only after consultation of all project partners and after authorization by the national funding agencies. Work package leaders will provide regular **progress reports** to the coordinator, while reporting to CoreOrganic/national funding agencies will be within the responsibility of the coordinator. The project website will provide **communication** for exchange of information within the consortium and to the outside world; therefore emphasis will be put on presenting major results in a generally understandable way.

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Appendix I: Detailed financial plan

13. Staff salaries (k€)	% of full time in the project	% of full time in curr. pos.	2007	2008	2009	2010
Main applicant (ARC/ BOKU)						
A. Sessitsch	17	100	0	0	0	0
E. Hackl	25	100	12.683	26.103	27.646	13.823
Technician (S. Schönthaler)	25	100	12.683	26.103	27.646	13.823
Ph.D.	100	100	15.250	30.500	30.500	15.250
J. Friedel	5	100	0	0	0	0
Field technician	20	100	5.485	9.685	9.967	1.324
Other staff (Co-applicants)						
GSF (D)						
M. Schmid	10	100	0	0	0	0
Ph.D. student	100	100	12.575	25.150	25.150	12.575
FIBL/ ACW/ ART (CH)						
B. Duffy	5	100	0	0	0	0
F. Widmer	5	100	0	0	0	0
G. Wyss	6/5/22/40	100	4.000	6.250	22.350	20.100
P. Mäder	8/6/6/7	100	3.500	5.500	5.750	3.750
Ph.D. student	100	100	12.350	26.800	29.000	14.935
SLU (SE)						
J.K. Jansson	10	100	0	0	0	0
Field assistant	10	100	2.300	4.500	4.500	0
Ph.D.	100	100	25.000	50.000	50.000	25.000
DFVF/ RUAV (DK)						
A. Dalsgård	21	100	0	0	0	0
D. Baggesen	8	100	0	0	0	0
Post-Doc microbiology	50	100	16.835	34.680	35.720	18.396
Post-Doc risk assessment	11	100	5.612	0	17.860	0
Post-Doc model experiments	17	100	11.223	11.560	11.907	0
Technician	22	100	7.064	21.828	0	0

Appendix I: Main applicant

MAIN APPLICANT: ARC/ BOKU (A)

Angela Sessitsch, ARC (A)

	% in PathOrg	% in position	2007 [€]	2008 [€]	2009 [€]	2010 [€]	
Dr. Angela Sessitsch (in kind)	17	100	11.056	22.813	24.280	12.140	
Dr. Evelyn Hackl	25	100	12.683	26.103	27.646	13.823	
Technician (S. Schönthaler)	25	100	12.683	26.103	27.646	13.823	
Ph.D.			15.250	30.500	30.500	15.250	
Consumables			8.000	16.000	16.000	8.000	
Travel			1.500	2.500	2.500	1.500	
Other costs:							
shipping			500	500	300		
final workshop						15.000	
communication/publication					1.000	1.000	
Sub-contract PRI-WAU (NL)			3.000	5.000	6.000	6.000	
Total costs			**64.672**	**129.519**	**135.872**	**86.536**	416.599
In kind contribution			11.056	22.813	24.280	12.140	
Costs requested			**53.616**	**106.706**	**111.592**	**74.396**	**346.310**

Jürgen Friedel, BOKU (A)

PathOrganic

BOKU: Surveys (WP2), field and green-house experiments (WP3)	Cost/yr in 2006 (€)	Amount	2007 7 Months	2008 12 Months	2009 12 Months	2010 5 Months	Total 36 Months	**Money applied for**	In-kind contribution (BOKU)	% In-kind (BOKU)
Personel										
Senior scientist	78030.96	0.05	2275.90	4018.59	4135.64	0.00	10430.14	0	10430.14	
Scientist	51570.00	0	0.00	0.00	0.00	0.00	0.00	0	0.00	
Post graduate	30150.00	0	0.00	0.00	0.00	0.00	0.00	0.00		
Field technician	32440.00	0.2	3784.67	6682.64	6877.28	0.00	17344.59	17344.59		
Total Personel		0.25	6060.57	10701.23	11012.92	0.00	27774.72	17344.59	10430.14	
Consumables										
	Seeds		0.00	200	200	0.00	400.00	400.00		
	Bags, Scissors, diverse materials		0.00	350	350	0.00	700.00	700.00		
Total Consumables			0.00	550	550	0.00	1100.00	**1100.00**		
Equipment			0.00	0.00	0.00	0.00	0.00	0.00		
Total equipment			0.00	0.00	0.00	0.00	0.00	0.00		
Travel										
	Field trips		500	700	700	0.00	1900	1900		
Total Travel			500	700	700	0.00	1900	**1900**		
Total			6560.57	11951.23	12262.92	0.00	30774.72	**20344.59**	10430.14	
					15% Overhead			3051.69	1564.52	
					Total			**23396.27**	11994.66	34%

Appendix I: Co- applicant´1 **CO-APPLICANT 1: GSF (D)**

Michael Schmid, GSF (D)

	2007* [€]	2008 [€]	2009 [€]	2010* [€]
Ph.D. student	12,575	25,150	25,150	12,575
Consumables	6,000	12,000	12,000	6,000
Travel	1,000	2,000	2,000	1,000
Sum	17,075	34,150	34,150	17,075
10% admin overhead	1,707.50	3,415	3,415	1,707.50
Total	**18,782.50**	**37,565**	**37,565**	**18,782.50**

* 6 months

In-kind contribution: Participation of Michael Schmid in the project is financed by GSF.

Appendix I: Co-applicant 2 CO-APPLICANT 2: FIBL/ ACW/ ART (CH)

G. Wyss, P. Mäder, B. Duffy, F. Widmer

Personnel:

	Staff	% in project	Euro salary
2007	B. Duffy	5	2’675 (not paid by CORE)
	F. Widmer	5	2’500 (not paid by CORE)
	G. Wyss	6	4’000 (paid by CORE)
	P. Mäder	8	3’500 (paid by CORE)
	New Hire (PhD student)	100	12’350 (paid by CORE)
Total/year			**19’850**
2008	B. Duffy	5	5’350 (not paid by CORE)
	F. Widmer	5	5’000 (not paid by CORE)
	G. Wyss	4	6’250 (paid by CORE)
	P. Mäder	6	5’500 (paid by CORE)
	New Hire (PhD student)	100	26’800 (paid by CORE)
Total/year			**38’550**
2009	B. Duffy	5	5’350 (not paid by CORE)
	F. Widmer	5	5’000 (not paid by CORE)
	G. Wyss	22	22’350 (paid by CORE)
	P. Mäder	6	5’750 (paid by CORE)
	New Hire (PhD student)	100	29’000 (paid by CORE)
Total/year			**57’100**
2010	B. Duffy	5	2’675 (not paid by CORE)
	F. Widmer	5	2’500 (not paid by CORE)
	G. Wyss	40	20’100 (paid by CORE)
	P. Mäder	7	3’750 (paid by CORE)
	New Hire (PhD student)	100	14’935 (paid by CORE)
Total/year			**38’785**

Other costs:

	Consumables	Travel	Other expenses
2007	6’000	3’650	0
2008	12’000	7’300	0
2009	12’000	7’300	0
2010	6’000	3’650	0

Recapitulation Costs for CoreOrganic (in Euro)

	Staff	Consumables	Travel
2007	19’850	6’000	3’650
2008	38’550	12’000	7’300
2009	57’100	12’000	7’300
2010	38’785	6’000	3’650
total	**154’285**	**36’000**	**21’900**
over all	**212’185**		

Appendix I: Co-applicant 3 **CO-APPLICANT 3: SLU (SE)**

J.K. Jansson

Budget category	2007 [€] (July-Dec)	2008 [€]	2009 [€]	2010 [€] (Jan-June)
Personnel				
Field assistant (10% on project; 100% full time)	2300	4500	4500	0
Ph.D., to be hired (100% on project)	25000	50000	50000	25000
Phytotron costs (*rent of GMO-secure growth chambers*)	4000	8000	8000	0
Material costs	5000	10000	10000	5000
Travel costs	1000	2000	2000	1000
Total	**54500**	**109000**	**109000**	**46000**

Appendix I: Co-applicant 5 **CO-APPLICANT 5: DFVF / RVAU (DK)**

D. Baggesen and A. Dalsgård, DFVF/ RVAU (DK)
(Revideret efter møde med Erik Steen Kristensen, d. 14.03.07), Kurs 1 EURO = 7,5 Dkr.

Budget Core Organic				2007		2008		2009		2010		Total	
Personnel	% of full time in the project (% of 36 months - total number of man months applied for)	% of full time in current position (% of 36 month - 3 years of 12 months)	Current salary DKR/ month	man months	€	man months	€	man months	€	man months	€	man months	€
AC post doc microbiology	50	50	42,087	3	16,835	6	34,680	6	35,720	3	18,396	18	105,631
AC post doc risk assessment	11	11	42,087	1	5,612	0	0	3	17,860	0	0	4	23,472
AC post doc model experiments	17	17	42,087	2	11,223	2	11,560	2	11,907	0	0	6	34,690
Technician	22	22	26,491	2	7,064	6	21,828		0	0	0	8	28,892
Personnel - total				8	40,734	14	68,068	11	65,487	3	18,396	36	192,686
Materials					5,000		25,000		15,000		10,000		55,000
Travel					600		550		550		600		2,300
Equipment					0		0		0		0		0
Co-financing DFVF			55,000	0.5	3,667	1	7,553	1	7,780	0.5	4,007		23,007
Co-financing RUAV			55,000	1.5	11,000	2.5	18,883	2.5	19,450	1	8,013		57,346
					61,001		120,055		108,267		41,016		
Overhead					12,200		24,011		21,653		8,203		
Total incl. co-financing					73,201		144,066		129,921		49,219		396,407
Total excl. co-financing					**55,601**		**112,342**		**97,245**		**34,795**		**299,983**

In-kind contribution: Participation of Anders Dalsgård and Dorte Lau Baggesens in the project is co-financed by DFVF and RUAV.