



Annual Status Report 2001 and Application for Continuation in 2002

For research projects financed by grants from
The Directorate for Food, Fisheries and Agro Business
under the Danish Ministry of Food, Agriculture and Fisheries

1. Research program

Research in organic farming 2000-2005 (DARCOF II)

2. Project title and number

1.12 Preventing mycotoxin problems

3. Head of project

Susanne Elmholt
Senior Scientist, Ph.D
Danish Institute of Agricultural Sciences
Department of Crop Physiology and Soil Science
Research Centre Foulum (RCF)
P.O.Box 50, DK-8830 Tjele, Denmark
Phone: +45 8999 1858. Fax: +45 8999 1619. E-mail: susanne.elmholt@agrsci.dk

4. Participating institutes

Danish Institute of Agricultural Sciences
Department of Crop Physiology and Soil Science
Research Centre Foulum (RCF)
P.O.Box 50, DK-8830 Tjele, Denmark

Danish Institute of Agricultural Sciences
Department of Agricultural Engineering
Research Centre Bygholm (RCB)
Schüttesvej 17
DK-8700 Horsens, Denmark

Technical University of Denmark (DTU)
Department of Biotechnology
Mycology Group
Søtofts Plads, Building 221
DK-2800 Lyngby, Denmark

5. Contact persons

Susanne Elmholt, Department of Crop Physiology and Soil Science, Research Centre Foulum, P.O.Box 50, DK-8830 Tjele, Denmark, Phone: +45 8999 1858. Fax: +45 8999 1619.
E-mail: susanne.elmholt@agrsci.dk

Erik Fløjgaard Kristensen, Department of Agricultural Engineering, Research Centre Bygholm Schüttesvej 17, DK-8700 Horsens, Denmark, Phone: +45 7629 6032. Fax: +45 7629 6100.
E-mail: ErikF.Kristensen@agrsci.dk

Ulf Thrane, Department of Biotechnology, Technical University of Denmark (DTU), Søtofts Plads, Building 221, DK-2800 Lyngby, Denmark, Phone: +45 4525 2630. Fax: +45 4588 4922.
E-mail: ut@ibt.dtu.dk

6. Other project staff

Helle Hestbjerg, Scientist, Ph.D , Danish Institute of Agricultural Sciences, Department of Crop Physiology and Soil Science, Research Centre Foulum, P.O.Box 50, DK-8830 Tjele,

7. **Start of project:** July 1st 2000
End of project: December 31st 2004
-

8. Annual report/Application for continuation in 2001

A. Objectives and expected achievements (from application)

PREMYTOX aims to prevent mycotoxin problems in cereals. The project has two major objectives:

- to increase our knowledge on the ecology of mycotoxin producing fungi
- to provide the farmer with information on the importance of mycotoxin producing fungi and practical means to reduce the dissemination and proliferation of these fungi

It is the objective of PREMYTOX to identify some of the control points in the primary production, which are critical in the prevention of mycotoxin problems in organic farming in Denmark. This knowledge will be achieved on the basis of mycological analyses of cereal samples from field experiments. The achieved knowledge will regard both pre-harvest and post-harvest aspects. Focus will be put on species producing ochratoxin A and deoxynivalenol, the two mycotoxins currently regarded to be the most important in Danish cereals.

An important achievement of PREMYTOX is that most of the obtained results will also be of use in conventional farming, which is also subjected to mycotoxin problems.

PREMYTOX will contribute to the general knowledge on the ecology of important mycotoxin producing fungi. This is needed to develop a general HACCP procedure for cereal production. The Mycology Group at DTU will secure a close contact between PREMYTOX and a currently starting EU project on OA, in which they are participating. The EU project aims to implement a general HACCP for cereal production in the European Union. As the HACCP concept focuses on critical control points, our results on critical points which are of special importance to organic farmers in Denmark, can contribute to the value of the EU-project.

Finally, one of the most important achievements of PREMYTOX will be the dissemination of knowledge on the importance of mycotoxin producing fungi and practical means to reduce the spreading and proliferation of these fungi. This knowledge will be made available to both farmers and extension service in the form of popular papers and a video, showing the importance of the control points, which are demonstrated to be critical.

B. Project summary (from application)

Mycotoxins are naturally occurring compounds and some of them constitute a severe threat to the health of humans and animals. In Danish grown small cereals, ochratoxin A (OA) and trichothecenes are considered to be the most important mycotoxins. Opposed to compounds like pesticides and antibiotics, which are excluded from organic farming, the mycotoxin problems cannot be totally eliminated. They can, however, be reduced very much if fungal growth and mycotoxin formation is inhibited by suitable management practices. Several reports and observations indicate that organically produced cereals are sensitive to mycotoxin contamination, stressing the relevance of this subject within the framework of DARCOF. The two major objectives of the project 'PREMYTOX' are to increase our knowledge on the ecology of mycotoxin producing fungi and to provide the farmer with information on the importance of mycotoxin producing fungi as well as practical means to reduce their dissemination, proliferation and toxin formation. The experimental part of PREMYTOX will focus on management practices, which are relevant to the general practice in organic farming and which are known or assumed to affect the OA producing *P. verrucosum* and the trichothecene producing species of *Fusarium*. Our work will address both preharvest and postharvest aspects with a main emphasis on seed quality, harvest practice, and drying facilities. One objective is to evaluate the effect of a new drum drying technique on the occurrence of fungi on bread grain. During the course of the project, information on how to obviate mycotoxin problems will be made available to farmers and extension service in the form of popular papers and a video, stressing those management practices, which PREMYTOX demonstrates to be critical.

Table 1: Work package list (from application)

No.	Work package title	Participants*	Budget (1.000 DKr)	Start	End	Deliverable No.
1	Project co-ordination, synthesis and dissemination of existing knowledge and PREMYTOX results to farmers and extension service	<u>SE</u> , HEH, EFK, UT	1078	2000	2004	WP1-D1-D8
2	General practice in organic farming regarding sowing, harvest, transportation, drying and storage of cereals	<u>SE</u> , DAAC	50	2000	2000	WP2-D1
3	Implementation of drum dryer facilities for bread grain and the effect of drum drying on the grain mycobiota with special regard to OA- and trichothecene-producing species	<u>EFK</u> , <u>SE</u> , UT, Drabæks Mølle	201	2000	2001	WP3-D1
4	Effect of drying practice on OA- and trichothecene-producing fungi	<u>EFK</u> , <u>SE</u> , UT, HEH, Drabæks Mølle	964	2001	2003	WP4-D1-D2
5	Effect of seed quality, harvest practice and other critical control points on OA- and trichothecene-producing fungi	<u>HEH</u> , SE, UT	1558	2001	2004	WP4-D1

* Responsible participants are underlined

C. Progress

C.1 Annual description (resume) of main results and conclusions

C.2 Fulfilment of tasks and deadlines in individual work packages

WP1: Project co-ordination, synthesis and dissemination of existing knowledge and PREMYTOX results to farmers and extension service	Time schedule according to application	Deviations, if any*
Task		
1. to co-ordinate work within PREMYTOX	Whole period	
2. Synthesis and dissemination of results	2001 - 2004	
Deliverables		
WP1-D1-D4: 1 st to 4 th annual report 2000-2003	2000 - 2003	
WP1-D5: Final report	2005	
WP1-D6: DARCOF report, which summarises the so-far obtained results on the ecology of the OA-producing <i>P. verrucosum</i>	2001	DJF Report 53, Scientific paper submitted 2001 and Grøn Viden 2002
Milestones		
WP1-M1-M5: Annual project meeting 2000-2003	2000 - 2003	
WP1-M6: Mid-term conclusions on critical control points and their implementation into WP4 and WP5	2001	2002
WP1-M7: Collection of material for use in the video presentation on how to prevent mycotoxin problems	2004	In progress

* *Deviations are discussed at C3*

WP2: General practice in organic farming regarding sowing, harvest, transportation, drying and storage of cereals	Time schedule according to application	Deviations, if any*
Task		
1. Questionnaire to organic farmers in Denmark	2000 to 2001	Results extended by a Post Doc project
Deliverables		
WP2-D1: Report on the results drawn from the questionnaire	2001	
Milestones		
WP2-M1: Questionnaire prepared and distributed to local advisors	2000	
WP2-M2: Questionnaires filled in and returned	2000	

Deviations are discussed at C3

WP 3. Implementation of drum dryer facilities and the effect of drum drying on the grain mycobiota with special regard to OA- and trichothecene-producing species	Time schedule according to application	Deviations, if any*
Task		
1. Technical modifications and implementation	2000	
2. Optimising drum drying	2001	
3. Analyses of fungi and mycotoxins	2000-2001	Mycotoxin analyses uncertain
Deliverables		
WP3-D1: Report and/or popular paper	2002	
Milestones		
WP3-M1: Technical modifications completed	2000	
WP3-M2: Analyses of baking quality completed	2000/2001	
WP3-M3: Mycological analyses completed	2000/2001	Hopefully we'll obtain results on field fungi others than <i>Fusarium</i>
WP3-M4: Drum drying procedure for use in 2002 in WP4 established	2001	2002

Deviations are discussed at C3

WP 4. Effect of drying practices on OA- and trichothecene-producing fungi	Time schedule according to application	Deviations, if any*
Task		
1. Different drying practices	2002	
2. Analyses of fungi and mycotoxins	2002-2003	
Deliverables		
WP4-D1: Popular paper on the results from WP4-1 and WP4-2 (e.g. Grøn Viden)	2003	
WP4-D2: Scientific paper on the effect of harvest time and drying practice on the grain mycobiota with special regard to OA- and trichothecene-producing species of <i>Penicillium</i> and <i>Fusarium</i>	2004	
Milestones		
WP4-M1: Grain samples from different drying procedures distributed to RCF and DTU	2002	
WP4-M2: Mycological analyses completed	2003	
WP4-M3: Analyses for OA and DON completed	2003	Mycotoxin analyses uncertain

* *Deviations are discussed at C3*

WP 5. Effect of seed quality, harvest practice and other critical control points on OA- and trichothecene-producing fungi	Time schedule according to application	Deviations, if any*
Task		
1. Screening for naturally contaminated seed	2001-2002	
2. Performance of field experiment	2001-2003	
3. Analyses of fungi and mycotoxins	2001-2004	Mycotoxin analyses uncertain
4. Study of hot spot contaminations	2002-2004	In progress
Deliverables		
WG5-D1: Scientific paper(s) on the effect of seed quality, harvest practice and 'hot-spot' formation on <i>P. verrucosum</i> and <i>Fusarium</i>		
Milestones		
WG5-M1: Obtaining naturally or artificially contaminated seed for use in 2002 and 2003	2001-2002	Samples will be obtained from the Danish Plant Directorate
WG5-M2: Performance of field experiment 2002 and 2003	2002-2003	
WG5-M3: Mycological analyses completed	2003-2004	

* *Deviations are discussed at C3*

C.3 Discussion on the progress, incl. deviations and achievements in the project as a whole and in the individual work packages and

PREMYTOX is progressing according to the original plans. The first annual project meeting was held in Foulum at March 26th 2001. This meeting focused at activities concerning WP1-WP3. Dissemination of results is a major theme of WP1. During the project period our results and experiences on mycotoxin prevention have been addressed in a review paper (Elmholt & Kristensen, 2001), at field days at Foulum (Elmholt, 2001d) and at seminars with grain dealers (Elmholt, 2001c, 2001e). Prior to the harvest of 2001, some of the critical control points in ochratoxin prevention were presented in Landsbladet (Elmholt, 2001b).

A report on general harvesting and drying practice has been made in co-operation with DAAC (WP2), based on a questionnaire distributed by DAAC to fifty-six farmers (Høy, 2001). Results from this will be used in the detailed planning of project activities. During the project period we have initiated a formalised collaboration with Aurion, Hjørring in the form of an "Innovative Post Doc" project on *"Initiatives to prevent mycotoxins in cereals, cf. Section G.* This project will contribute to the information on general practice in organic farming today.

The preliminary trials regarding drying of rye (WP3) have shown that drum drying is a very effective treatment to reduce fungal abundance of the grain (Kristensen, 2001a, 2001b). However, the baking quality of the grain will be affected too. The amylograph viscosity will increase at increased drying temperatures. Likewise, the ability of water absorption is higher in flour made from drum dried rye than in flour made from cold-air dried (untreated) rye. The analyses of the samples from the 2001 trials are expected to give sufficient results to clarify this topic. It is expected to be possible to optimise the drum drying technique for drying of bread rye on the basis of the accomplished drying tests when the analysis work is completed.

Relating to WP5, a M.Sc. project (Maiken Haase, biology, University of Århus) has been initiated with the purpose to study hot spot contaminations in natural (on-farm) and artificial storage conditions.

At the moment we seem able to extend our collaboration with the mycology group at DTU. They have recently started other activities on mycotoxins, cf. Section G. We intend - and hope to be able to - coordinate some of our analyses in order to obtain knowledge on field fungi others than *Fusarium* and on

the genetical similarity of *P. verrucosum* isolates from different localities and from soil and grain samples respectively.

Regarding mycotoxin analyses (ochratoxin and trichothecenes), cf. WP3-Task 3 (and at a later time in the project WP4-Task 2 and WP5-Task 3) PREMYTOX faces a problem. In the original application we outlined an agreement with the Department of Analytical Chemistry (DAC, Foulum) that they would implement existing GC/EC methods for the detection and quantification of trichothecenes and an HPLC method for the detection and quantification of ochratoxin. This objective cannot be fulfilled due to a coming reorganisation of the DAC department. Samples from this harvest have therefore been frozen and we hope for a solution to this problem, because mycotoxin analyses are extremely expensive at commercial laboratories.

WP1

Our plan was to present a DARCOF report this year, which was to summarise so-far obtained results on the ecology of the OA-producing *P. verrucosum* (WP1-D6). This plan has been changed and the results have been/will be published in the following way:

- A review on "Grain without mycotoxins" has been published in a DIAS report on "The Production of Quality Grain in Denmark (Elmholt & Kristensen, 2001).
- Our results on the occurrence of *P. verrucosum* in organically and conventionally cultivated soil and in organically cultivated grain will be presented in a scientific paper entitled "*Ecology of Penicillium verrucosum: Natural occurrence in field soil and grain with special attention to farming system and on-farm drying technique*". This paper will be submitted to the scientific journal *Biological Agriculture and Horticulture* this year.
- Based on results from the above mentioned papers we will address critical control points in growing, harvesting, and drying practice and disseminate these informations to extension service and farmers. At the moment we have in mind a "Grøn Viden", currently entitled "Undgå ochratoksin i korn". It will be published in July prior to the harvest of 2002.

Concerning WP1-M6 (Mid-term conclusions on critical control points and their implementation into WP4 and WP5), this milestone has been postponed to the annual meeting in March 2002, where the detailed planning of WP4 and WP5 will take place. Concerning WP1-M7: Collection of material for use in the video presentation on how to prevent mycotoxin problems. This work has started and is in progress and will be continued during the rest of the project period.

WP2

The questionnaire was made in co-operation with DAAC. It was distributed by DAAC to fifty-six farmers, chosen by postal code and assumed by DAAC to be representative of organic farmers in Denmark. Forty-three of these answered the questionnaire. About 50% of these farmers perform on-farm drying. A report on behalf of these results has been written by DAAC (WP2-D1; Høy, 2001). The farmers were asked questions concerning management (farm size, livestock, crop rotation, seed treatment, harvesting, drying facilities (materials used, fan size, aeration, heating, cooling). Most of the reported on-farm drying facilities were in-bin drying and storage or natural air drying systems. Only one had a continuous flow dryer. A few of the farmers had no drying facilities but left their grain to dry on the floor (approx. 0.75 m depth) with frequent inversions with a shovel. The conclusion is that only two of these farmers – according to their own opinion – have had problems with a poor grain quality. According to DAAC their problems are related to contamination by wet seeds of weed and poor drying facilities. The latter is especially important when using PVC drains for ventilation in natural air drying systems.

WP3

During the harvest of 2000, preliminary trials with drum drying of rye were made and test samples from the trials were analysed during the winter of 2000/2001 with regard to their content of fungi and quality for bread production (WP3-M2 and M3, 2000).

As regards fungi, the findings show a great variation in content between samples of grain processed at different temperatures. The results indicate that major reductions in fungal abundance are achieved for both yeasts and filamentous fungi by using a fixed drying air temperature of e.g. 200°C for a short

time (approx. 4 min). A similar effect was obtained using a lower temperature (150°C) and a longer process time (approx. 5-6 min.). Using fixed grain temperatures (77°C) for 5-6 min. had a very good effect too. As regards the quality for bread, all samples were analysed for falling number. No evident effect – positive or negative – on falling number was seen with the applied treatments temperatures and process periods. The falling number in the untreated rye ranged between 249 and 281. After drum drying of grain at maximum temperatures between 49 and 88°C the falling number ranged between 237 and 284. Three of the samples (untreated grain, grain at a maximum temperature of 49°C and grain at a maximum temperature of 87°C) were analysed by amylograph tests and baking tests. For the grain treated at 49°C the amylograph test showed slightly higher viscosity, and for the grain treated at 87°C a much higher viscosity compared with the untreated grain. The ability of water absorption was clearly effected, and it was highest for the grain treated at highest temperature. The baking tests showed equal weights and volumes for bread made from all three samples.

The initiating work on the technical modification and changes of construction of the existing drum dryer plant is now finished (WP3-M1). Prior to the harvest of 2001 the drum dryer was equipped with a PLC based monitoring program and control system, which made it possible to carry out the planned investigations concerning the influence of temperature and process time on the quality of grain.

A total of 48 single drying or heat treatment tests with rye from the harvest of 2001 have been carried out. The tests were made according to a test design made in order to ensure that the influence of harvest time, process time and drying temperature on the grain quality during the process of drum drying might be clarified. Organically grown rye was used for the trials. The rye was of the variety *Dominator* and supplied from a field at The Ecological Research Station, Rugballegård. Rye from two different harvest times was used. The first harvest date, corresponding to an early harvest, was August 15th, while the remaining rye was harvested on August 30th. At both harvest times, the moisture content of the grain was about 17.5%. Tests at fixed drying air temperatures were performed at drying air temperatures between 118 and 300°C. Tests at fixed grain temperatures were performed at temperatures between 43 and 79°C. Three different process periods were used, i.e. 4, 10 and 15 minutes.

WP4

No activities in the current period.

WP5

A M.Sc. project (Maiken Haase (MH), biology, University of Århus) has been initiated with the purpose to study hot spot contaminations in natural (on-farm) and artificial storage conditions. During autumn 2000, MH performed a case study at an organic farm at which we had observed problems with *P. verrucosum* in an earlier study. The farm is owned by a part-time farmer and converted to organic farming in 1989-92. It has a stock of Gotland Sheep and a natural air drying system, in which the grain is placed in a pile on the floor of the barn. Floor and side-wall are made of concrete. Main and side ducts are made of chipboard and the perforated bottom of the side ducts is made of plywood. Side ducts are covered with old grain hessian sacks. Sampling was performed in rye and oats as to illustrate, whether conidia of *P. verrucosum*, which had survived in the ducts and the hessian sacks could contaminate the new harvest. MH found increasing numbers of contaminated kernels during the drying period and significantly higher numbers of contaminated kernels near the bottom of the grain heap than in the average samples, indicating a contamination via the drying facilities.

D. Description of plans and future work in the project as a whole and in the work package (Including plans for publication and communication)

WP1

In the coming period, WP1 will focus on publication (scientific paper, Grøn Viden as described above), mid-term conclusions on critical control points, collection of material for the video presentation, and co-ordination of work within the project (WP4 and WP5) as well as with other projects when possible (cf. Section G).

WP2

This work package is fulfilled according to the objectives in the application. Conclusions will be incorporated in the mid-term conclusions on critical control points. However, information on general practice regarding drying and storage will be extended by results from the "Innovative Post Doc" project on "*Initiatives to prevent mycotoxins in cereals*", which was started in August 2001 in co-operation with Aurion.

WP3

Test samples from the trials will be analysed with regard to content of fungi and quality for bread production. This work is currently in progress. Foulum (Susanne Elmholt) performs dilution platings to assess the number of viable propagules on the grain surface (all treatments, in progress), screenings on DYSG for *P. verrucosum* (seven statistically selected treatments, completed) and ergosterol content in the grain (all treatments, to begin in November).

DTU (Ulf Thrane) is screening grain samples (seven treatments, in progress) on *Fusarium* selective media according to the plans. Preliminary counts of *Fusarium* show that the drying processes do reduce the percentage of viable *Fusarium* colonies from the grains. The identification of the colonies is in progress. We have initiated a collaboration with Birgitte Andersen (BA) DTU, cf. Section G. Currently it is the plan that BA will examine the field fungi (others than *Fusarium* spp.) of the rye samples sent to DTU.

The analyses regarding baking quality will be completed within a few months. Drabæks Mølle is working on the falling number analyses. Amylograph analyse and baking test will be made on selected samples.

Results of the mycological analyses will be related to drying parameters in order to enable optimum settings for the studies in 2002 (WP3-M4).

WP4

Details regarding WP4 will be settled at the project meeting in spring 2002. At the moment there seem to be no other changes in plans than those relating to mycotoxin analyses as described earlier.

WP5

We have decided to use naturally infested grain in our field experiments with *Fusarium*. To obtain this grain without having to screen a large number of grain samples we have established a co-operation with Afdelingsleder Ib Dinesen at the Danish Plant Directorate. Each year they perform regular screenings of numerous grain samples. They receive samples of approx. 1 kg and this is sufficient for the small plots planned to be sown at Foulum. Because of other project activities we have decided to perform the field experiments with a spring-sown species, probably barley. Infested samples will be obtained from Ib Dinesen.

The importance of "hot spots" in the contamination of stored grain by *P. verrucosum* will be elucidated in the M.Sc. project by Maiken Haase (MH). During the next two months she'll follow an experiment set up with 4 species of grain (rye, oats, wheat and spelt). Barley kernels inoculated with conidia of *P. verrucosum* serve as hot spots.

E. Project publications**1. Articles in international, scientific journals with review procedures****2. Presentations at congresses, symposiums etc.**

Elmholt, S. (2001a) Environmental perturbations as revealed by shifts in fungal populations. Invited speaker at workshop "Fate and Effects of Microbial Inoculants" at LO-skolen, Helsingør, 6th May 2001.

3. Articles in agricultural journals etc.

Elmholt, S. & Kristensen, E.F. (2001) Korn uden mykotoksiner, pp. 45-55. In: Waagepetersen, J., Petersen, J.B., Knudsen, L., Deneken, G. & Jørgensen, J.R. Produktion af kvalitetshvede i Danmark. En oversigt over problemer og muligheder. DJF rapport 53. Danmarks JordbrugsForskning, Foulum.

Elmholt, S. (2001b) Forebyg svampegift i korn. Den faglige baggrund, Landsbladet, 10. august.

Høy, J.J. (2001) Økologisk kornopbevaring. Rapport fra spørgeskemaundersøgelse. Landbrugs Rådgivningstjeneste, Skejby. 2 pp.

Kristensen, E.F. (2001a) Ny tørringsteknik kan gøre økologisk korn bedre (New drying technique may lead to improvements in organically grown grain) (in Danish). JordbrugsForskning, 5, p. 12.

Kristensen, E.F. (2001b) Tromletørring god til øko-korn. Ny tørringsteknik kan fjerne svampe fra økologisk korn (Drum drying suitable for eco-grain. New drying technique for elimination of fungi from organically grown grain) (in Danish). Økologisk Jordbrug, 243, p. 9.

4. Other presentations at meetings, field days etc.

Elmholt, S. (2001c). Hvad ødelægger kvaliteten af økologisk korn? Oral presentation at seminar on Grain Quality for dlG ØKOLOGIs øko-salgskonsulenter, FAF, Gamle Havnekaj 25, Odense, 9th January 2001.

Elmholt, S. (2001d). Mykotoksinproducerende svampe på korn. Markvandring, Foulumgård, 14th June 2001.

Elmholt, S. (2001e) Svampe og toksiner. Oral presentation at seminar for dlG employees, FAF, Gamle Havnekaj 25, Odense 10th October 2001

F. Scientific education (ph.d. and post doc.), including visiting scientists and visits abroad

There is a close collaboration between this project and the Innovation Post. Doc. project of Helle Hestbjerg, "*Initiatives to prevent mycotoxins in cereals*", described below.

G. National and international co-operation

During the project period we have initiated a formalised co-operation with a biodynamic/organic mill/bakery (Aurion, Hjørring) in the form of a post doc project, financed by the research council (SJVF), Aurion and DIAS. The title of the project is "*Initiatives to prevent mycotoxins in cereals*". The project addresses the ochratoxin A producing *Penicillium verrucosum* as well as trichothecene and zearalenone producing species of *Fusarium*. The project will include studies of the susceptibility of old species and cultivars towards these fungi. There is a need for these studies due to a growing consumer interest in e.g. one-grained wheat (*T. monococcum*), emmer (*T. dicoccum*) and spelt (*T. spelta*) and a better taste and a higher quality than modern cultivars of wheat. The purpose of this project is to improve the possibilities of Aurion to guide their growers and employees in the handling of grain both on-farm and in the bakery in order to prevent fungal growth and mycotoxin formation. In co-operation with Aurion the project furthermore aims to develop new and improved methods to reduce the abundance of critical fungi by brushing the grain. Samples of one-grained wheat, emmer and spelt (*T. spelta*) will be analysed for the occurrence of and their susceptibility towards important toxigenic fungi. Methods of brushing the grain will be optimized to reduce the abundance of fungal spores. This project will run from 2001-2003.

In order to obtain naturally infested grain for the field experiments in WP5 we have established a co-operation with Afdelingsleder Ib Dinesen at the Danish Plant Directorate.

We have initiated a co-operation with Birgitte Andersen (BA), Flemming Lund (FL) and Jens Frisvad from the Mycology Group at DTU. Birgitte Andersen is participating as an assistant

research professor in the project "Prevention of fungal growth and mycotoxin production in Danish foods". The objective of this project is to study colonisation, survival and mycotoxin production by field fungi, primarily *e.g. Alternaria* spp., on grain, apples, pears, onions and tomatoes. Currently it is the plan that BA will examine the field fungi (others than *Fusarium* spp.) of the rye samples sent to DTU.

Flemming Lund and Jens Frisvad are participants in the Danish part of the OTAPREV project (Prevention of ochratoxin A in cereals), headed by Monica Olsen from Sweden and part of the EU's 5th framework. One purpose of this project is to elucidate whether there exist different strains/clones of *P. verrucosum* and if so how this relates to their habitat and their mycotoxin producing ability. At the moment we discuss the possibility to include a range of the isolates, which we have collected from soil and grain samples during recent years. Information like this will be highly relevant in a risk assessment.

In relation to the EU OTAPREV project, Erik Fløjgaard has answered a questionnaire, distributed by Keith Scudamore, regarding general harvesting, drying and storing practice in Danish farming.

Regarding mycotoxin analyses, we are trying to establish a collaboration with chemists at RISØ (Gerda Krog Mortensen) and the Agricultural University (Hans Christian Bruun Hansen) - who are working with natural toxins from plants and fungi - as well as with chemists at the Danish Veterinary and Food Administration, DVF (Peter Have Rasmussen, Kevin Jørgensen), who are responsible for the survey of ochratoxin and trichothecenes in Denmark. Currently we are applying with RISØ, KVL and DVF to initiate a project within the frame of "Komplementerende Forskning i FØJO II". The objectives of this project are to analyse samples in PREMYTOX for mycotoxin contents as well as to develop and evaluate simple methods for toxin analyses.

,

