# ENDURE

European Network for Durable Exploitation of crop protection strategies

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FOOD and Quality and Safety

# *Deliverable DR2.8*

# Follow-up report on implementation of arable crop system studies

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# Summary

Reduction of pesticide use in arable crops not only need improving crop protection practices or substituting non-chemical techniques (genetics, biological control) but also redesigning the cropping system and enlarging scales to multi-pest, crop rotations and landscape interactions. RA2.6 Arable Crops System Case study aims at:

- designing and exploring a range of scenarios of innovative systems
- making a qualitative *ex ante* assessment, comparing these systems between them and with the existing ones for multiple criteria
- identifying conditions that would help adopting such innovative (research gaps, market incentives, public policies)

The first phase of the 2nd JPA (workshops in Copenhagen and in Paris) discussed which cropping systems situations would better support this systems approach and foster integration between sub-activities within ENDURE (crop specific case studies, innovative technologies, landscape ecology, assessment methodology, plant genetic resistance). This led to the selection of two typical arable cropping systems:

- Winter Crops Based Cropping Systems (France, Denmark, UK and Germany);
- Maize Based Cropping Systems (Italy, Hungary, France, Spain, Northern Europe).

A potato based cropping system has also been considered but it was found less relevant for these purposes. However, potato experts will be invited to the workshops presenting results and outcomes of RA2.6.

For each cropping system, a working group has been set up which includes a core group and representatives of other ENDURE sub-activities. The general approach undertaken by working groups is a desk study which will:

- characterize pest situations and crop management practices for Current Systems and Existing Advanced Systems in some European regions;
- analyze the coherence of current crop protection systems;
- design Innovative Systems (through a Scenario building approach)
    - Explore the potential of new combinations of existing practices (e.g., new crop rotation/integrated crop management)
    - Explore new technologies and approaches (not yet validated): detection methods, habitat manipulation, semio-chemicals, new genotypes;
    - Explore « non-technical » leverages, e.g., insurance schemes to reduce risk variability,
- analyze Innovative Systems and compare them to existing systems (in collaboration with RA2.4/RA3.1 sub-activities)
    - carry out and expert-based assessment of performances (using the *ex-ante* assessment tool designed by subactivity RA2.4);
    - identify potential drawbacks in their adoption by stakeholders (through Focus groups);
    - identify conditions which would facilitate the adoption of innovative systems (Public policies, Market incentives, Extension) and discuss a research agenda (e.g., breeding targets);

In addition to these two working groups on winter crops and maize based rotations, a meta-analysis on rotational effects is launched. Rotations are an important component of RA2.6 leverages (introduction of new crops into current rotations). RA2.6 will conduct an investigation, using data available across the partners, into these effects by building on a preliminary analysis conducted at Rothamsted Research. This task will feed both working groups.

To implement this overall approach, the two working groups set up a specific workplan. They will share their experience and results during one joint RA2.6 meeting. One of these meetings will be dedicated to expert-based assessment of systems. Potato experts as well as some other relevant ENDURE partners will be invited to attend these joint meetings.

# 1. Minutes of the 1st RA2.6 meeting (Copenhagen 4th April 2008)

**Participants:**
P. Kudsk (AU, coordinator of RA1)
L. Jorgensen (AU, coordinator of the wheat case study)
B. Melander (AU, coordinator of the integrated weed management case study)
G. Cordsen Nielsen (DAAS)
I. Denholm (RRES)
N. Evans (RRES)
S. Koch (JKI)
U. Heimbach (JKI)
B. Golla (JKI)
J. Kiss (SZIE)
M. Sattin (CNR)
P. Spoorenberg (WUR)
C. Lamine (INRA, RA35)
M. Morrison (INRA)
A. Messéan (INRA, coordinator of RA2)

**Apologies:** ACTA could not attend the meeting but the INRA proposal for France had been discussed with ACTA prior to the meeting (X. Pinochet/D. Gouache).

The meeting aimed at discussing arable crop system studies and coming up with specific objectives and proposals. Participants were invited to prepare proposals.

## 1. Reminder about the rationale and the implementation of "system studies"

Breakthroughs in crop protection result not only from innovative technologies or better crop management practices, but also from adopting system-based approaches that take account of interactions between crop protection, agronomy, ecological and landscape factors as well as the socio-economic framework in which strategies need to be implemented.

The challenges identified within ENDURE include:
- adopting a system-based and interdisciplinary approach to redesign crop protection systems;
- designing (and assessing) innovative crop protection strategies that may not yet be economically viable, socially acceptable or even technically feasible on a short-term basis.

1. Promoting alternative practices or innovative systems may need considering various levels of the agricultural production environment which forms a coherent system:

- the cropping system level: there is a coherence between choice of variety, sowing date and density, nitrogen fertilisation and application of growth regulators, herbicides, insecticides and fungicides;
- the farming system level for which there exists a coherence between intensive crop management, work organisation and available machinery;
- at the advisory system level: coherence between the intensity of cropping systems, sources of technical advice and the content of the disseminated technical information;
- at the supply chain and regulatory level: e.g., coherence between intensive cropping systems and susceptibility of variaties to diseases;
- at the market level: effects of commodity prices and "consumer demands";

Indeed, if farmers use their current practices, they do have reasons for that. We may consider that their practices are not optimal in terms of economic and ecological balance. Discrepancy between what we would call “optimal” or good practices may be due to lack of information, lack of training and this should be addressed within ENDURE but it may also be related to other bottlenecks: farm organisation, agronomic constraints, market incentives and social aspects.

The coherence of agricultural practices should thus be analyzed from a broad perspective, by finding out bottlenecks. This coherence analysis requires bringing together many disciplines: agronomy, plant pathology, economics, sociology, etc.

2. Designing really innovative crop protection strategies needs considering emerging technologies (DNA-based detection techniques, robotics, IT, etc), introducing new genes into plants as well as exploring the potential of landscape management of cropping systems or deployment of semiochemicals for reducing pest incidence. These aspects are addressed within RA2 and/or RA4 subactivities but it would be useful to assess their potential on practical cases when they are combined and integrated into integrated production strategies. This requires addressing the landscape level and the lay-out of crops over landscape and as well as considering non-crop land.

3. System studies should foster integration within ENDURE by setting up “working system case studies” for which ENDURE research activities and various disciplines would have to sit together and collaborate in order to:
(i) analyze the current coherence of farmer practices in terms of crop protection, understand why farmers behave like they do and identify key bottlenecks;
(ii) redesigning crop protection systems by mobilizing innovative approaches (e.g., detection methods, precision agriculture, habitat manipulation, deployment of semiochemicals) and exploring “socio-economic” leverages (e.g., insurance schemes to mitigate variability that might result from alternative systems);

4. System studies should produce new scientific knowledge

This has been reminded by the ENDURE project officer recently and should be kept in mind when implementing our action plan.

<u>Implementation of arable crop system studies”</u>

The objectives of “regional system studies”, as discussed in Versailles, are to:

a. Analyze the coherence of current crop protection strategies
    - Select farming systems whose crop protection is clearly not using best available practices;
    - Analyze the coherence of crop protection systems and why farmers are using « non-optimal » practices (addressing if necessary, the different components of the agricultural system, i.e., including farming system, market incentives, needs social sciences);
    - Identify bottlenecks and analyze out how to overcome them (training, incentives, etc);
b. Explore various scenarios for redesigning these crop protection systems;
    - Explore the potential of innovative approaches: detection methods, precision agriculture, habitat manipulation, deployment of semiochemicals;
    - Explore « socio-economic” leverages (insurance schemes),
    - Identify targets for basic research (e.g., plant breeding “ideotypes”, plant architecture) → « reverse engineering »

- Bring together all competences available in RAs: RA1 (short-term case studies), RA22 (innovative technologies), RA23 (landscape ecology), RA24 and RA3 (ex-ante assessment of innovative strategies) and RA4;
- Mobilize disciplines (sociology, economy, agronomy, ecology, biology, plant health);

In order to create synergy, make it easier their implementation and save money, regional system studies should, as far as it is possible, take place on regions where:

- ENDURE partners are already involved (case studies, assessment, landscape studies, etc);
- Crop protection systems are usually considered “not optimal” from the agronomic point of view national;
- Datasets describing their main characteristics are easily available (GIS, statistics on agricultural practices and economic performances, information on advisory systems, market features, etc);

**2. <u>Presentation of proposals by partners (presentations to be posted on the web site)</u>**

Each participant presented a proposal:

- INRA proposed to address Oilseed Rape (OSR)/winter wheat/other cereal rotations through two regional case studies and to focus on the effect of crop management and spatial arrangement of crops to mitigate; it is proposed to focus on two pests (pollen beetle and blackleg) and to use spatially-explicit models for designing innovative cropping systems at the landscape level and to analyze their implications on the rotation;
- WUR proposed to take advantage of existing datasets and field studies to address RA2.6 objectives; there exists a lot of information on rotational effects and the effect of rotation on pest incidence need not to be proven; nevertheless, it should be summarized and transferred to farmers;
- RRES proposed to take advantage of the Farm Scale Evaluation database, to extend to similar datasets and to assess the effect of rotations on weeds and draw generic conclusions;
- RRES also presented the initial specific OSR case study and how it could fit into the arable crop system study;
- JKI proposed to compare two OSR-based integrating farming systems which differs by the percentage of OSR in the cropping system (20-25% vs 35-50%) and to analyze the consequences on the economy and pest profiles. Landscape aspects such as spatial arrangement of rotation, field-to-field distance are incorporated;
- AU submitted a proposal on the incidence and impact of weeds, diseases and pests under the influence of tillage, crop rotation, location and chemical control level for cereal-based rotations; two long term field experiments are available and analyze the effect of introducing spring cereals and reduced tillage; DAAS also has a network of field trials which could inform on the effect of some technical practices (e.g., sowing dates);
- SZIE proposed to take advantage of the analysis of integrated crop management of maize-based rotations (which started in 2005/2006) and to work very closely with the ENDURE maize case study (focusing on fusarium, weed and rootworm issued) by addressing system aspects;
- CNR proposed to design new and sustainable maize-based systems through expert groups and existing datasets on performances.

<u>Outcome of the discussion:</u>

- There exists a lot of datasets on past and current cropping systems which should be shared and analyzed to come up with generic conclusions on the impact of each individual component of the cropping system on pest incidence;
- Sources of information are long-term field experiments, regional case studies or National monitoring networks (although it might be difficult to get information from such networks);
- Although less information is available on the effects of spatial patterns on pest incidence and pest regulation, models are being developed and would be a useful tool to address system issues;
- The original OSR case study objectives could be integrated into RA2.6 through the OSR-based rotation studies that have been proposed by several partners;
- Close relationship with past and starting crop-specific case-studies is crucial but this should not be a problem as RA2.6 is co-coordinated by the RA1 leader and several case study leaders are directly involved (L. Jorgensen for wheat, H. Scheepers for potato, B. Melander for weed management, J. Kiss for the maize case study as well as N. Evans for the OSR proposal).
- A general framework for RA2.6 has been set up (see below) and will be further discussed in June in the second RA2.6 workshop which will include other subactivities.

## 3. Description of work

It was agreed to proceed with the followings tasks:

1a Meta-analysis on rotational effects (April 2008 – June 2009)

First, a questionnaire to identify existing datasets on rotational effects and pest incidence which are available within ENDURE will be elaborated and sent out to all ENDURE partners. This will complete the already identified datasets.

- Long-term field experiments
  - Weeds: DK (AU), FR (SCI), UK (FSE), I?
  - Disease, Pest?
  - Cropping systems: FR (La Cage?, Toulouse?, SIC Grignon, ), NL
- Farm survey: WUR
- Monitoring systems: DEFRA (UK), PV (FR), ...

➔ The questionnaire will be designed by RRES (D. Bohan and I. Denholm) by end of April and discussed with P. Kudsk and A. Messéan;
➔ The questionnaire will be sent to ENDURE partners beginning of May and return is expected by end of May;
➔ The analysis of the questionnaire (relevance of datasets) will be carried out by cropping system and discussed at the June workshop:
  - winter cereals rotation (P. Kudsk): DK, DE ?, FR?
  - potato-based rotation (H. Schepers) : NL, FR ?
  - OSR-based rotation (N. Evans): UK, FR, DE, DK?, others?
  - Maize-based rotation (J. Kiss): HU, I, FR?

Third, datasets will be analyzed (impact of rotations on the economic performances, pest incidence, pesticide use and environmental impacts - biodiversity, energy, ... -) and discussed within an interdisciplinary working group (economists (1-2), agronomists (1-2), pathologists, entomologists, weed scientists and other subactivities).

As for crop protection, all pests, disease and weed aspects should be considered. In addition the lay-out of cropping systems over landscape and the rotational dimension have to be included.

This would lead to generic conclusions and, as far as possible, rules for constructing innovative rotations.

1b Analysis of the coherence of crop protection systems

This task should answer why farmers are using « non-optimal » practices (addressing if necessary, the different components of the agricultural system, i.e., including farming system, market incentives).
It is proposed to perform:

- A review of existing studies on the subject: WUR (see Piet's talk), INRA (Gedupic), etc → as far as it is possible, joint datasets with 1a;
- A path-dependency analysis (Claire for more details);
- Additional interviews on targeted cropping systems;

To implement the task, coordination of students across Europe (DK, FR, UK, DE?, HU, I?) with a common protocol for interviews is envisaged. This will be further discussed until June (lead Claire Lamine).

2 Model-based redesigning of crop protection (2008-2009)

It is proposed to set up a model-based framework for redesigning crop protection at the landscape level. In practice, four working groups by arable rotations (see above) will discuss how to improve such systems and what is the potential on innovative technologies and of landscape ecology to that purpose. Wherever models are available, they will be used : for example, for OSR-based rotations, SIPPOM and LandSFACTS models will be used to propose optimal spatial allocation to mitigate blackleg and implications on subsequent crops analyzed. In other cases, only expertise is available. Expertise from RA1 case studies, RA22 (innovative technologies, C. Ziljstra), RA23 (Landscape ecology, C. Lavigne), RA42 (genetic resistance, C.-E. Durel). Practical implementation to be discussed in June.

3 Ex-ante assessment of innovative crop protection systems and transfer (2009-2010)

Proposals from tasks 1 and 2 will be evaluated in relation with tools designed by RA24 (ex ante assessment of crop protection) and RA3. In addition, focus groups gathering stakeholders will be organized to discuss the innovative (and non existing!) systems

4. Recommendations

At the end of ENDURE, system studies should inform other activities related to :

- Incentives – public policies
- Training – Advisory system
- Monitoring systems
- Education

## 4. Action plan

1. Minutes of the meeting (15 April, AM)
2. Comments by participants on the minutes (30 April, All)
3. Presentations posted on the web site + papers (20 April, AM)
4. Questionnaire on rotational datasets (30 April, RRES)
5. Response to questionnaire (31 May, ENDURE partners)
6. Analysis of the questionnaire (10 June, P. Kudsk, H. Schepers, N. Evans, J. Kiss)
7. 2nd meeting (10 and 11 June, Paris, from 10:30 on the 10th to 3pm on the 11th, AM);

# 2. Minutes of the 2nd RA2.6 workshop

## Arable Crop System studies within ENDURE: rationale, scope and instructions for implementation

Minutes of the second kick-off meeting
Paris, 10-11 June 2008
Release 1.0
A. Messean

**Participants:**
P. Kudsk (AU, coordinator of RA1)
L. Jorgensen (AU, coordinator of the wheat case study)
B. Melander (AU, coordinator of the integrated weed management case study)
J. Pedersen (DAAS)
D. Bohan (RRES)
U. Heimbach (JKI)
A. Veres (SZIE)
C. Moonen (SSSUP)
W. Sukkel (WUR)
C. Zijlstra (WUR, RA2.2)
X. Pinochet (ACTA/CETIOM)
C. Lamine (INRA, RA3.5)
C. Lavigne (INRA, RA2.3)
M. Morison (INRA)
E. Pelzer (INRA)
N. Sapoukhina (INRA, RA4.2)
A. Messéan (INRA, coordinator of RA2)
P. Ricci (INRA, coordinator of ENDURE)

The meeting aimed at implementing the actions decided at the kick-off meeting in Copenhagen. In addition to RA2.6 partners, subactivities RA2.2, RA2.3, RA3.5 and RA4.2 had been invited to attend in order to foster integration between disciplines and activities.

Antoine Messéan reminded the participants about the rationale of system studies within ENDURE and the three actions decided in Copenhagen:

- Action 1a Meta-analysis of rotational effects on pest incidence;
- Action 1b Socio-economic analysis of the coherence of current crop protection systems;
- Action 2 Model-based redesigning of crop protection systems.

### 5. Action 1a Meta-analysis on rotational effects on pest incidence

It had been decided to launch an on-line questionnaire to identify and describe those existing datasets which could be included in such a meta-analysis. RRES prepared and posted the questionnaire mid-May and, by 10 June, 31 datasets from 7 countries had been described. David Bohan presented a short overview of these datasets (see powerpoint presentation).

David Bohan also reported on a rotational analysis currently being undertaken at RRES. This Restricted Maximum-Likelihood (REML) analysis used monocot, dicot and total weed seedbank counts from 256 fields sampled across the UK (Farm Scale Evaluation datasets). Each field had at least 7 years, and up to a maximum of 9 years, of crop sequence data. The aim of the analysis was to: 1) determine whether there is consistent way of viewing rotations;

2) evaluate the ecologically relevant duration of a cropping sequence; 3) simplify the crop sequences to common factors across crops and cropping practice; and 4) to estimate the effects of these rotations on weed seedbanks.

The analysis showed that three years of cropping sequence was important, explaining between 60 and
70% of the variation in the weed seedbank counts. The three year sequences could be simplified into factors with no loss of explanatory power. Best fit was achieved with factors constructed from the season of sowing (winter or spring), crop type (cereal, oilseed, vegetable, root crop and grass ley) and the herbicide target of weeds in the crop sown (monocot or dicot weeds). Interestingly, a geographical factor was not important, suggesting that similar rotational effects applied across the UK. We tested these rotational predictions against weed seedbank data gathered independently, the next year, from the same 256 fields. The weed seedbank counts found for extant rotations were not significantly different from prediction.
These findings suggest that consistent rotations have important effects on weed seedbanks. Our
validated rotational predictions explain the three order of magnitude differences in weed seedbank counts observed in the UK between fields.

The crop type is the major factor explaining differences in variables. In order to assess with more scrutiny the effects of other factors, e.g., crop management, it would be interesting to carry out the same statistical analysis on datasets by crop type.

D. Bohan proposed to extend the analysis methods, across Europe, using the data provided by ENDURE members. Data from some 31 trials have been entered in the ENDURE RA2.6 survey via the Virtual Laboratory. These data will form the basis of future extensions to the analyses. We would note that following the meeting it is clear that additional trials data are available in partner laboratories.
The analysis will be performed on weeds first (at least 5 countries submitted datasets). The underlying hypothesis is that the models we produce will be consistent across Europe. Specifically, effects will consist of a rotational effect and a geographic effect.

The same approach will be applied to counts of important invertebrate pest species: although the temporal dimension might not explain as much variability as for weeds, it was considered worth doing it and assess to what extent rotational effects might inform pest variability.
The spatial dimension might be addressed later depending on the outcome of this first meta-analysis and the availability of relevant datasets.

This proposal was agreed. As for crop type, special attention will be paid to winter crop rotations (including cereals and OSR), maize-based crop rotations. This would make this analysis consistent with action 2 below.

A core group for this action 1 is set up:
- David Bohan (RRES);
- Andrea Veres (SZIE);
- Bo Melander (AU);
- Camilla Moonen (SSSUP);
- INRA will appoint a representative (Nicolas Munier-Jolain?).

The following action plan was agreed:
- Look for additional datasets on weeds and pests for these two major cropping systems;
- Select those datasets that should be included into the meta-analysis;
- Prepare a template for collating data from these selected datasets;

- Specify the statistical analysis to be carried out to be used;
- Estimate budget and resources requested (visiting scientist?);

A first draft is due by June 20th and final proposal to be submitted by June 30th.

## 6. Action 1b. Socio-economic analysis of the coherence of existing crop protection systems

C. Lamine proposed to:
- assess to what extent past and ongoing studies could inform on this issue;
- expand the same kind of path-dependency to other crops;
- carry out a pan-European survey based on interviews of farmers (who are using conventional practices, who are practicing IPM) and other relevant stakeholders such as advisors and researchers and to discuss both current practices and innovative strategies (in terms of feasibility and conditions of transition. This could be achieved thanks to the coordination of several students training periods in different countries involved.

Most participants said that the use of focus groups to discuss the feasibility and "acceptability" of alternative systems (proposed by ENDURE) would be much welcome. But this could not start now and should be closely linked with the other actions of RA2.6. Participants wondered if it would be worth starting by an analysis of current practices (including both conventional and existing alternative systems) or if we should wait for the outcome of other subactivities before setting up a survey and groups. Most participants showed potential interest but said they were not the adequate people to discuss it in details.

It was proposed to let Claire Lamine discuss an action plan with colleagues in social sciences from AU (Egon Noe), WUR (Jan Burmaa) and others (SZIE?, SSSUP?) and to come up with a proposal that would be discussed for the 3rd JPA (end of 2008).
After the meeting, J. Kiss confirmed that I. Madarasz could participate from SZIE side.

## 7. Inputs from other subactivities

Ra2.3 Landscape ecology (Claire Lavigne)

C. Lavigne updated us on the activity of RA2.3 as well as on the outcome of the IOBC working group "Landscape management for functional diversity" held in May in Bordeaux.
RA2.3 has started sharing datasets which could inform how landscape affects weed/pest dynamics and incidence. A report on the potential of landscape management is being prepared (M18).
As for weeds, local factors are more important that landscape (margins and adjacent fields are key component). Managing the landscape for a single pest enemy is not a solution and research should focus more on food webs.
A challenge is changing perspective and considering how landscape context impacts local populations/ communities. A better characterization of cropping systems is necessary and one must take into account the diverse possible functions of landscape management. There is a need for:

- detailed studies of functions of ecological structures + habitat analyses to adapt typology
- multidisciplinary approaches to incorporate the different players at the landscape scale

Ra2.2 Potential of innovative technologies (Carolien Zijlstra)

C. Zijlstra gave an overview of the forthcoming Ra2.2 reports which described molecular technologies and precision agriculture technologies that could help implementing alternative crop protection systems and/or reducing pesticide use. Innovative technologies might also help implementing system approaches by:
- analyzing multi-pest profiles very efficiently;
- helping deploying landscape management solutions through GIS and remote sensing techniques;
- ensuring reactivity in alternative systems by facilitating monitoring of pests;
- supporting integration of large amounts of data.
The approach is being implemented to maize and this should be connected with both the maize case study and this RA2.6 subactivity.
Timescale for using such techniques and economic balance were discussed.

Ra4.2 Plant genetic resistance (Natalia Sapoukhina)

N. Sapoukhina updated the group on Ra4.2 activities (creation of the SURE consortium) and presented models designed for deploying resistance genes across landscape.

## 8. Action 2 Model-based redesigning of crop protection systems

Muriel Morison presented how predictive models could help redesigning crop protection systems for winter crops rotations and analyzing the implications of novel cropping systems in terms of pest incidence.
Andrea Veres presented what SZIE was considering doing by comparing two study regions with maize-based rotations.

Two subgroups were then set up to start discussing how to set up alternative crop protection systems through expert-based and/or model-based knowledge. Each group started by identifying the typical rotations currently carried out in various countries as well as the major pest problems across Europe.

Short outcome of each subgroup:

1. Winter crops Cropping systems debriefing:
L. Jorgensen (AU), **B. Melander (AU),** J. Pedersen (DAAS), C. Lamine (INRA), U. Heimbach (JKI), E. Pelzer (INRA), M. Morison (INRA), A. Messéan (INRA), N. Sapoukhina (INRA), A. Messéan (INRA)

The group decided to study 4 different crop rotations of which one is monoculture of wheat. The crop rotations will include three crops: winter wheat, winter barley and winter oilseed rape. The decision on pests and scenarios to focus on will be taken at the first regular meeting of the group. Tentatively the group suggested to study three scenarios: reduced dependence on pesticides, 50% reduction and zero use of pesticides. There was some discussion on the scenarios that some considered to be more driven by politics than science. The group will establish a core group and the members of the core group are expected to participate in every meeting. Experts from other subactivities will be invited to provide input on specific topics.

2. Maize-based cropping systems
W. Sukkel (WUR), D. Bohan (RRES), P. Kudsk (AU), C. Moonen (SSSUP), C. Lavigne (INRA), P. Ricci (INRA), **A. Veres (SZIE),** C. Zijlstra (WUR)

Each group member presented basic facts about maize cultivation in their country. In Northern Europe maize are primarily grown for silage and very often in monoculture.

In Central and Southern Europe maize is grown for grain. In some regions, e.g. Northern Italy maize is grown in monoculture while in other regions/countries like Hungary maize is often rotated. The group listed a number of crop protection issues that system case study could address but the group realised that before a final decision could be taken they had to consult the maize case study. In the case study the focus should be on rotation and the potential benefits of rotating maize whereas the maize case study should primarily deal with specific pests and their control/prevention in the crop.

This brainstorming should now continue through several meetings to be held until M30 (July 2009) in order to come up with a deliverable including:

- alternative cropping systems scenarios taking advantage of most advanced science-based technologies;
- advantages/disadvantages, upcoming problems, performances of such systems;
- a research agenda (if necessary);

It is proposed to appoint two coordinators per group:

- Bo Melander and Neal Evans for the winter crop cropping system;
- Jozsef Kiss and Maurizio Sattin or Camilla Moonen for the maize-based cropping system.

A workplan (meetings to be held, members of each group, resources) is requested by mid-July.

## 9. Action plan

8. Minutes of the meeting (23 June, AM/PK)
9. Comments by participants on the minutes (30 June, All)
10. Presentations posted on the web site + papers (30 June, AM)
11. Protocol for the meta-analysis on rotational datasets (30 June, D. Bohan RRES)
12. Socio-economic analysis of coherence (end of 2008, C. Lamine, INRA)
13. Action plan for working subgroups on winter crops and maize (B. Melander/N. Evans and J. Kiss/M. Sattin by mid-July);