EUROCROP Executive Summary

		Sixth Framework Programme

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EUROCROP : Agricultural Research for Improving Arable Crops Competitiveness

Topic addressed: 8.1.B.1.1.6

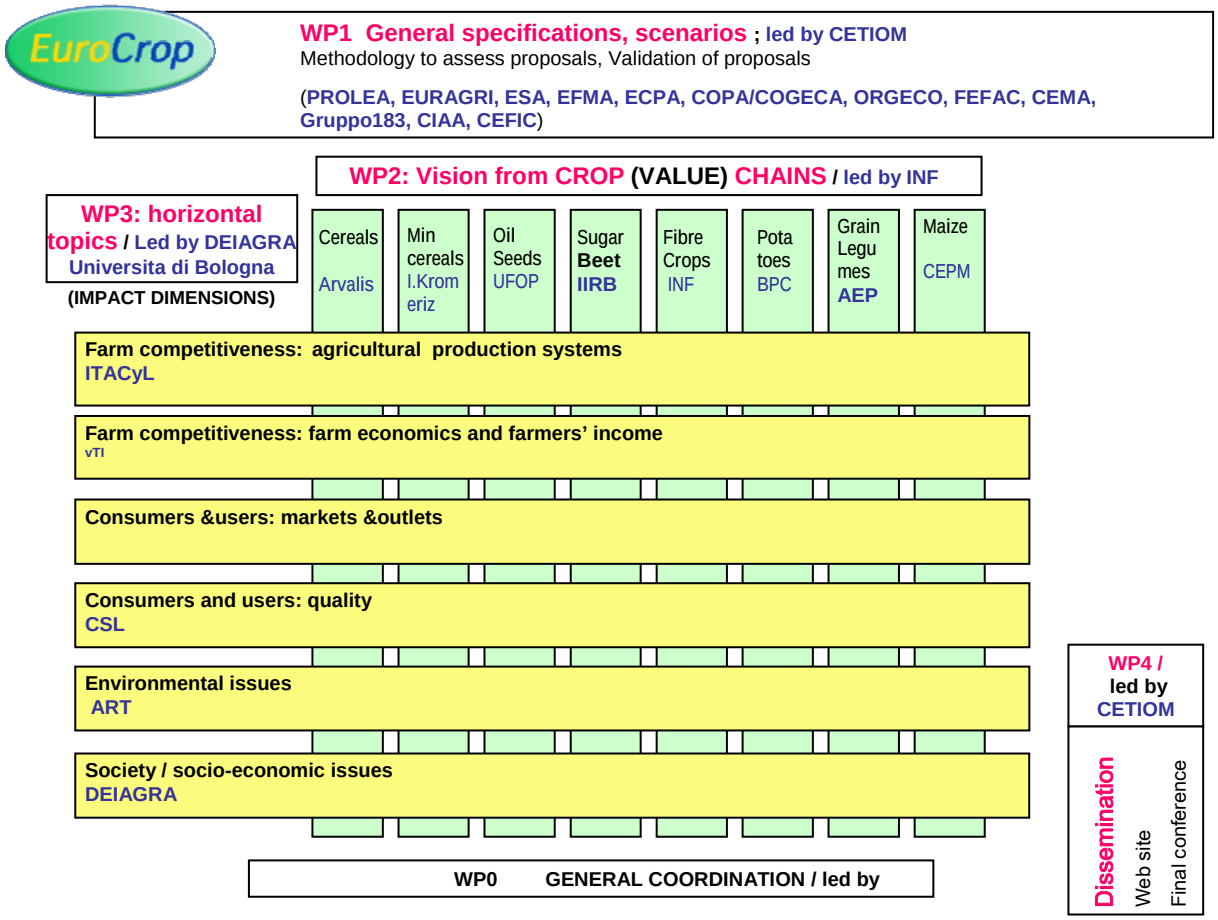
Call identifier: FP6-2004-SSP-4

Project status: ended December 2008

Starting date: 1st May 2006

Project description and principles

The European Commission wished to implement a place for discussion to enhance the exchanges between the scientific community and stakeholders concerning arable crop competitiveness, in order to strengthen its analysis of research priorities.



EUROCROP aimed to define a common vision for the future of research and development related to arable crops and proposed a strategic research plan for the arable crop (AC) sector with a horizon of 2015. This plan is briefly explained below, and final recommendations are explained on page 6 of this document.
EUROCROP brought together concerned stakeholders and actors to develop a collective analysis of research needs in order to improve the competitiveness of European arable crops, and to propose appropriate action.
The EUROCROP partnership included organizations using research, including farmers' organizations, and organizations providing research, innovation and extension services. Stakeholders and representative organizations of civil society in the field of environment preservation and consumer advocacy are integrated in the partnership of the project, and provided input in particular as members of the Project Advisory Committee (PADCO).To meet its goals EUROCROP operated according to a cross-cutting approach, first by arable crop (cereals, oilseeds, sugar beets, fibre crops, potatoes, grain legumes and maize), where the crop chain vision is considered in its entirety (WP2), in order to identify specific bottlenecks for increasing crop chain competitiveness. This vertical approach was then completed in WP3 by horizontal aspects of competitiveness including technical aspects at farming level, farm economics and production costs, outlets and markets, quality of agricultural products and environmental impacts, as well as social aspects.
These themes were addressed by specialists and invited experts in a series of workshops which mobilized the 26 partners' staff and 120 experts from approximately 100 institutions from different European countries.

What is arable crop competitiveness for EUROCROP?

This question was among the first subjects of debats during the July 2006 kick-off meeting in Brussels. The debates around competitiveness led to the consideration of a three-pronged approach:

- *markets, and economical competitiveness as a key component*
- *regulations dealing with social, sustainability and other miscellaneous aspects. Meeting regulations has a cost or a value for crop chain actors*
- *sustainability or social issues, not yet transformed into regulations or immediate costs or values; require that crop chain practices are verified as being cross compliant.*

For its works, EUROCROP distinguishes between two levels:
"Competitiveness C1": Economic competitiveness and markets, with two sub entries:

- Economic competitiveness of arable crops at farm level in EU countries (one crop versus other crops, arable crops versus other land uses): focus on yield, production costs, net income, farm economics (assuming the respect of current regulations, when enforced)
- Economic competitiveness of EU arable crops in markets: meeting the demand of industries and consumers (quantity, quality, specifications, regularity of production, market prices…): focus on quality, cost per unit produced, market access costs.

This first level is a more or less short/medium term approach.
"Competitiveness C2": Sustainability and social issues, which need assessment through indicators. EUROCROP examines the interactions between arable crop production and "external" factors of public interest, such as environmental issues and social issues (citizen demand, employment, rural life…), in a medium term/ long term approach.

EUROCROP – focus on two interactive levels

At the level of WP1 / PADCO + core group: a three-step strategic thinking process was developed, using basic retrospective and prospective approaches with 2015 as the horizon:

- Identification of the main challenges to guarantee AC competitiveness through to 2015:
  - Understanding and describing the European arable crop system (structure and dynamics)
  - Identifying potential changes and making hypotheses on the changes in the system and in its context
  - Identifying and analysing the strengths and weaknesses of AC
- Building scenarios for contexts
- Ranking research areas in terms of priorities and in coherence with the scenarios

At the scientific level (WP2 and WP3): the identification of priority areas was carried out through:

- preparatory work on the present status of research and knowledge, organized to take into consideration the main challenges and the weaknesses of AC
- identifying priority research areas and research challenges to fill the gap (expert groups)
- briefly describing the topics and deliverables expected in each research area.

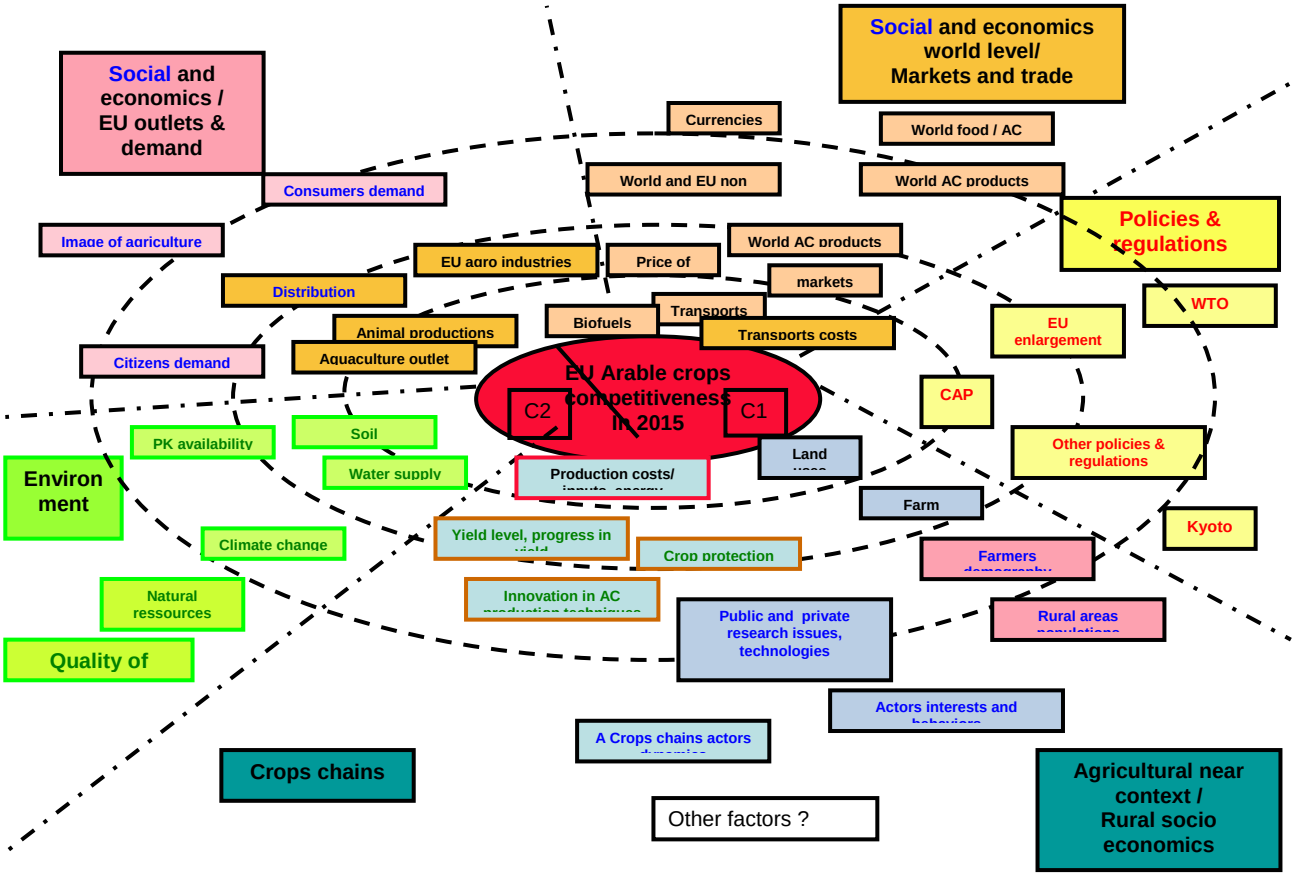
EUROCROP OUPUTS

The main results of the 32 month coordination action are:

- a strategic research plan structured under 5 major stakes, 36 challenges and 105 research goals / main questions to research
- a set of 4 scenarios used to propose priorities
- a set of 73 research topics, proposals to be submitted to policy makers and planners
- a European network of experts, who will continue to work beyond the end of the project to set up RTD projects.

The EUROCROP framework of thinking and scenarios

The consensus description of the arable crop system elaborated during the first year of the project is summarized in the following figure:



AC CROPS SYSTEM AND ITS ENVIRONMENT

Figure: EUROCROP landscape of factors

This consensus description has been used to identify the main stakes and challenges for AC competitiveness and to elaborate scenarios, based on different hypotheses concerning the evolution of the main factors.
Four (4) scenarios were elaborated and used to imagine research strategies answering each scenario, and to identify the research actions which appear to be necessary whatever the considered scenario, and which may be considered as major priorities. This second option keeps the favour of the project. Using scoring methods, the EUROCROP group elaborated research priorities for each scenario:
Scenarios are not intended to forecast the future, but to provide a framework for strategic thinking.

Table: Main characteristics of Scenarios identified

	SC1	SC2	SC3	SC4
TITLE	WTO agreement and expensive energy	Europe of regions	High environmental performance, green Europe	Challenge of global warming
MAIN DRIVER	WTO agreement is reached on basis similar to EU proposal and CAP is reduced, orientations are maintained	WTO agreement is not reached, lower economic growth, energy prices constant	A growing public concern about health and environment becomes a major driver of public policies. CAP is reoriented	Global warming becomes acute and leads the policies. CAP is reoriented
SECONDARY DRIVER	Sustained economic growth and high energy prices	CAP is reduced and decentralized to "regions" of Europe, on increased subsidiarity basis	WTO agreement is not reached, lower economic growth, energy prices constant	WTO agreement is reached on basis similar to EU proposal

Towards research strategies: the priorities common to all scenarios

The 36 challenges were scored according to the 4 scenarios. We distinguish 3 levels to characterize their importance:

- level 1 (red colour): the challenge scored in the top 25% of ranking scores in 3 of the 4 scenarios, and in the top 50% of ranking scores for all scenarios examined
- level 2 (dark purple colour): the challenge scored in the top 25% of ranking scores in 3 of the 4 scenarios, or scored in the top 50% for the 4 scenarios
- level 3 (light purple colour):): the challenge scored in the top 25% of ranking scores in 2 of the 4 scenarios, or scored in the top 50% for 3 of the 4 scenarios
- specific concerns ("wild cards"", bright blue): the challenge scored in 1st, 2nd or 3rd position in one of the scenarios (i.e. not considering this challenge could be a fatal mistake if the considered scenario occurs)

The results emerging from the project activities are summarized in table 7 and include the 50% higher priority challenges (18 over 36 challenges).

4 challenges appear as first level priorities for the sustainability of AC system competitiveness:
- food safety, which is a basic need of populations
- the maintenance of efficient crop protection, as a major guarantee for food security
- the improvement of resource use efficiency,: energy and water, of both short term economic interest and a fundamental issue for long term sustainability.

The 2nd level includes 4 supplementary challenges where economic competitiveness is predominant, dealing with yield level and stability improvement, optimisation of cropping systems and adaptation of production systems, and nutrient use efficiency (long term sustainability issue).

Then 3rd level priorities could be considered as secondary levers of competitiveness:
- managing risks for farmers (risks related to markets, climate variations…)
- developing non-food non-feed uses
- developing entrepreneurship and innovation capacity
- developing a positive public perception of AC

Specific concerns ("wild cards"):
- the integration of arable crops in rural territories, which are essential in the context of scenario 2. It appears as a clear priority in scenario 2, where competitiveness is determined at the regional level, but it should be considered that meeting this challenge could contribute to other political objectives, rural development being the first one.
- The 2 other "wild" challenges are key issues for scenario 4, related to climate change: to mitigate its effects and minimize further degradation (minimize GHG emissions per unit of product).

Table: common challenges in all scenarios

		SC. 1	SC. 2	SC. 3	SC. 4	COMMON
	CHALLENGES FOR ARABLE CROPS	**Rank of priority (over 36 chal.)**				
1.1	Increase level and stability of yields	1,0	4,0	18,0	11,0	✪✪
1.2	Technical and economic optimisation by innovating sustainable Cropping Systems	8,0	6,0	11,0	6,0	✪✪
1.3	Adaptation of production systems and crop rotations according to changes in farming framework conditions	16,0	15,0	17,0	14,0	✪✪
1.4	Managing risks for EU farmers	18,0	12,0	29,0	15,0	✪
2.3	**Ensuring food safety**	7,0	3,0	5,0	12,0	✪✪✪
3.3	Developing Non food/ non feed uses	12,0	23,0	14,0	13,0	✪
4.1	Improving resource use efficiency: nutrients	4,0	25,0	2,0	8,0	✪✪
4.2	**Improving resource use efficiency: energy**	2,0	10,0	2,0	4,0	✪✪✪
4.3	**Improved resource use efficiency: water**	3,0	16,0	4,0	3,0	✪✪✪
4.6	**Ensure an effective crop protection in the long term (integrated crop protection)**	17,0	2,0	1,0	5,0	✪✪✪
4.7	Minimize greenhouse gas emissions per unit of product	33,0	33,0	9,0	2,0	🏳
4.8	Maintain and improve soil quality	29,0	17,0	6,0	10,0	✪
4.10	Developing strategies to face climate diversity and climate change	36,0	35,0	15,0	1,0	🏳
4.11	Integrating different sustainability concerns in the design and implementation of innovative cropping systems	28,0	12,0	11,0	9,0	✪
4.12	Developing common sustainability assessment methods	35,0	24,0	8,0	6,0	✪
5.2	Reinforcing entrepreneurship and innovation capacity of AC systems	8,0	8,0	29,0	22,0	✪
5.4	Improving the integration of arable crops into rural territories and economies	19,0	1,0	21,0	33,0	🏳
5.6	Achieving a positive public perception of arable crops systems	23,0	8,0	16,0	18,0	✪

EUROCROP topics

Altogether, 73 research topics were described in the WP3 working groups (see full list in the final report and a detailed description in the WP3 report).

Among these topics:

- 35 are focussed on finding solutions, aiming at immediate applied needs, with applied results expected in the project duration.
- 5 call for research aimed at achieving basic knowledge and focus on understanding specific aspects in order to identify future solutions (in the fields of genetics of plants and pathogens, human nutrition, and soil sciences (biological aspects))
- 35 call for "system explaining research", focussed on understanding the functioning and behaviour of the system(s) in order to identify future solutions
- 4 ask for coordination action, targeting the coordination of current research and development activities, and the specification of new research activities.

This result reflects a situation in which systemic knowledge, which implies multidisciplinary approaches, remains the main bottleneck to progress in the field of agronomic sciences and arable crops.

The thematic connections between the EUROCROP topics allow for the clustering of topics or meta-topics for AC competitiveness:

- innovating cropping systems and assessment (6 topics)
- genetics and breeding (3)
- quality, process and genetics (3+1)
- nutritional quality (6)

- food safety (3)
- soil aspects (4)
- water use (4)
- nitrogen (3)
- sustainable crop protection (3+3)
- energy optimisation (3)
- green house gas emissions (3)
- climate change (3)
- sustainability assessment (2)
- land use (2)
- whole crop use (2)

The remaining 19 topics are more or less independent from these clusters.

Only 27 out of 73 topics were found to show similarities or overlapping with already existing research projects from the 6th Framework Program, hence demonstrating that EUROCROP has been innovative and challenging to the *status quo.* It also emphasises the need for different EU research strategies for AC.

The full list of EUROCROP topics is as follows:

1.01 Increasing yield potential of varieties by breeding for tolerance to abiotic and biotic stresses
1.02 Improving control on Weeds/Pests/Diseases through better crop rotations, alternative crops and cropping systems
1.03 Increasing yield stability through genetic resistances to crops enemies (weeds, pests and diseases) based on breeding
1.04 Production of varieties tolerant to drought, N deficiency, weeds, pests and diseases through understanding crops reactions to stress and tools for breeding
1.05 Avoiding compaction and reduce soil erosion
1.06 Develop crop and farming systems capable of improving soil chemical properties (organic matter, salinisation)
1.07 Improve soil biological properties: increasing soil biodiversity by adequate cropping systems
1.08 Improving water use efficiency of crops: varietal evaluation and breeding
1.09 Water efficient cropping systems through improved crop mix and irrigation management
1.10 Sustainable irrigation in relation to water and soil (drainage, salinisation)
1.11 Reducing greenhouse gas emissions of cropping systems
1.12 Evaluation of different farm types concerning the sustainability of their cropping systems
1.13 Forecasting of pests and diseases taking into account cropping and management system and crop canopy sensibility
1.14 Preserving the durability of crop protection means
1.16 Optimizing crop rotations in reduced or no tillage conditions
1.17 Management of crop rotations aimed to prevent and control weed infestation, disease and pest infection
1.18 Anticipating/forecasting the changes of climatic conditions and their effects on crops
1.19 Innovating for improved energy efficiency of cropping systems
1.20 Understanding and calculating energy costs in crop chains and at farm level through new methods and references for energy balance of cropping systems
1.21 Breeding for crop species with improved N uptake and nitrogen efficiency
1.22 Developing reduced nitrogen input and productive cropping systems: nitrogen optimization at cropping system scale
1.23 Better use of manures: treatment , application, timing

2.01 Production systems and rotations: impact of increasing commodity and inputs prices on production systems
2.02 Economics of farm size: economies of farm size under changing market and policy conditions with focus on new member states
2.03 Adopting consistent policies: designing improved contractual options to allow flexible access to land for farming in the new Member States (MS)
2.04 Economics of adaptation to climate change
2.05 Establishment of a common methodology for the quantification of the carbon footprint to compare production systems in selected regions of Europe
2.06 Economics of straw removal: identify different local conditions for straw removal in Europe and analyse their impact on supply costs

2.07 Establish competitive crop rotations for bioenergy: analyse the contribution of different crops and crop rotations to bioenergy yields and their economic and ecological impacts in selected regions of Europe
2.08 & 1.15 Risk management and adaptation of arable farming under price volatility and climate change
2.09 Researching new activities and possibilities for farmers in the new market situations and new tools for rural development.

3.01 Optimising AC for the development of new healthy products
3.02 Optimising AC for optimal utilisation of nutrients in human and animal nutrition and/or utilisation of components of AC or by-products of food processing for non-food applications
3.03 Preventing safety risks in arable crops
3.04 Whole crop utilization
3.05 Strategies to enhance nutritional quality and processability of crop products and by-products from food industry, bioenergy or biorefinery to secure supply to the European feed sector
3.06 Improvement of competitiveness of crop production on the global feed and related markets: strategies for competitive EU feed production
3.07 Science-based integration of feed crops and related animal products in consumer health concerns
3.09 Land use optimisation for Non-food/Non-feed, Food and Feed, and synergies between production and services in the EU, regional and farm scales
3.10 Sustainable whole crop use optimisation for non-food/non-feed, food and feed, and synergies between different outlets
3.11 Agro-industrial parks and land use: closing the regional mass and energy cycles integrating agricultural production, processing, mass flow and logistics and providing balanced services to society

4.01 Better understanding of the genetic determinants of quality traits to help develop better cultivars capable of delivering required quality in the face of abiotic stress
4.02 Better understanding of the interaction between processing methods and nutritional quality of produce in order to optimise bio-availability
4.03 Development of co-existence strategies for EU arable crops with GM and non-food crops
4.04 Better understanding of the interaction between crop quality characters and processing, to identify areas for improvement and development
4.05 Development of pest and disease control measures to protect and enhance product quality
4.06 Develop and improve carbon footprints for EU produce and develop agreed standard methods for their determination across Europe
4.07 Better understanding of public concerns associated with GM technologies to help shape communication strategies
4.08 Development of information transfer programmes to increase production and use of EU-derived plant proteins
4.10 Optimise the digestibility of plant proteins in animal diets

5-1.1 Environmental and economic optimization of (low-input) cropping systems
5-1.2 Use of new technologies/methods to increase the efficiency of crop management
5-1.3 Linking arable crop production to livestock farming
5-1.4 Physical, chemical and biological aspects of integrated soil protection
5-2.1 Designing and testing water efficient cropping systems in a multi-scale approach
5-2.2 Global assessment of N emissions of cropping systems
5-2.3 Integrated assessment of management strategies for different climatic scenarios
5-3.1 Efficient biodiversity enhancement
5-3.2 Integrated and novel approaches for effective crop protection strategies
5-3.3 Deal with new and emerging pathogens (pests, diseases, weeds)
5-3.4 Scaling issues: find sustainable solutions on different scales
5-3.5 Evaluate the best regions for crop production

6.01 Definition of services for improving farmers' orientation, sensitiveness and adaptability to the market
6.02 Designing EU policy for improving arable crop competitiveness in consideration of globalization and the main uses of crops: food, feed, energy, biomaterials.
6.03 Deprivation and quality of life in rural areas: provision of public and social goods and services
6.04 Connection between land consolidation and arable crops

6.05 Comparative analysis and identification of the innovation opportunities and barriers to increasing efficiency in the arable crop chains and networks
6.06 Structure and interaction between arable crops and urban planning
6.07 Open innovation
6.08 Analysis of farmer awareness of market trends and identification of knowledge gaps
6.09 Analyze factors serving to promote entrepreneurship at EU level
6.10 Analyze trust throughout value chains and networks related to arable crops
6.11 Value chains and networking: analyze value chains and market power

EUROCROP RECOMMENDATIONS

Considering the priorities coming from the scenarios approach, the discussions of the open conference held in Brussels (17th 0ctober, 2008 - see final report), and the priorities proposed by the core group on more scientific and technical bases (December 2008), **EUROCROP recommends the initiation of new research projects on 4 main themes in priority, *which appear to be of high common interest :***

A: Risk management and adaptation of arable farming

Risks in AC farming vary and are related to farm income (due to input/output price volatility), quantity and quality of production (due to weather variability and climatic change) and farm assets – real estates and human capital. The objectives are to find general solutions for arable farming and farms in order to minimize individual categories of risks by improving farm practices, diversification of production, investment, business orientation and devising innovative risk management tools. Such efforts should include the identification and classification of risks related to arable farming under new/expected conditions; the assessment of the significance of risks, their size and evaluation; the analysis of instruments for risk reduction, e.g. insurance; and decision support systems for a rapid adaptation to economic contexts and risk management. The management of risk in a chain and network perspective should be considered, taking into account connections of AC with rural households, upstream and downstream actors, as well as contract design issues.

B: Designing resource-efficient and sustainable cropping systems.

Increased resource efficiency is certainly key for arable cropping system competitiveness. Partial solutions to the problems of efficiency are known for single factors (energy, water, nutrients, impacts on resources, pollution etc), but not always coherent for different objectives and aspects of global efficiency. Innovation must be developed at the cropping system scale. A major need and research question is the design and global optimization of new cropping systems.

The action aims at designing innovative cropping systems which optimize the use of the limited resources energy, water and nutrients (N, P, K and other). The efficiency of resource use in terms of output units produced per resource unit used should be maximized. At the same time these resource efficient-cropping systems need to be sustainable in economic, environmental and social terms.

These innovative cropping systems should be tested in different regional contexts of Europe (including pedo-climatic and socio-economic aspects) and the effectiveness of the progress regarding efficiency and sustainability must be assessed.

Cropping system development should include long-term experiments (farming systems and poly-factorial experiments), on-farm research to test the practicability of the improved system and the acceptance by farmers. An interdisciplinary approach is recommended (agronomic and environmental sciences, economy, social sciences, innovation sciences, etc.)

C: Limiting the impact of AC cropping systems on greenhouse gas emissions (role in climate change)

Agriculture, animal husbandry and forestry (including deforestation) are thought to cause around 20% of the world's Greenhouse Gas Emissions. Arable crop systems are included due to the use of N fertilizers and soil tillage practices. The two major greenhouse gases emitted by European cropping systems are CO_2 and N_2O. N_2O is characterized by a high global warming potential. In the past, a great deal of work was undertaken on the relationship between crop management and one specific channel of nitrogen loss (NO_3, NH_3 N_2O, etc.). However, there are some trade-offs between the reduction of different kinds of N emissions: e.g. reducing NH_3 emissions by increasing N in soil leading to higher NO_3 leaching. An experimental dataset on those trade-offs is needed, especially on N_2O. A global approach accounting for the multiple sources of greenhouse gases is necessary, because the ways of decreasing emissions from one source may increase the emissions from other sources.

The action would aim to better understand the effect of cropping systems on greenhouse gas emissions in order to be able to optimize crop management and cropping systems with the objective of reducing these emissions, and to gain further knowledge on the interactions between the different N emission sources. It should include simulations of the effect of crop management practices on GHG emissions and the implementation of experimental databases necessary to validate the models. Experiments and network of pluri-annual experiments are needed..

D: Better understanding of public concerns regarding AC production and products and communication with global and local societies

The fears of consumers and citizens with respect to science and technologies used in agriculture and food industries have been growing for more 15 years, and arguably increasing in intensity on the occasion of repeated crises. These fears and concerns deal with food safety, on one hand, and environmental and social impacts on the other. Such concerns are seen to be hampering the wider use of innovative technologies in Europe, and may place additional burdens on industry. They cause an increasingly dualistic vision of agriculture -intensive polluting agriculture versus environmental organic agriculture). On another level, the image of agriculture and Arable Crop production systems in the public opinion is key for the future legitimacy of public support to the sector. Consumers and citizens are more than ever faced by contradictory choices (including prices, social and environmental impacts of consumption etc).
There is a need for AC agriculture to better understand the general public's concerns, to provide informed, balanced advice and comments with an eye to developing a new relationship between the AC sector and society, and a need for consumers to obtain factual information for better informed choices.
The action aims to better understand the EU general public's concerns over AC based food and AC production processes, to propose actions and contents for public information, to enhance relations between the sector and representative stakeholders.

These recommendations are proposed assuming that:

- integrated crop protection, which is a key concern for AC competitiveness, will be covered in the continuity of ENDURE project, and follow up actions will be proposed. Establishing links with EUROCROP topics and research goals would be advisable.
- food quality/safety aspects are already covered by the project BIOTRACER
- the contents of NITROEUROPE project only partially overlap with the recommendations of EUROCROP, which recommend strengthening an agronomical approach for greenhouse gas emissions.

Proposals of written topics for titles A, B, C and D are included in the final report.

It must be reminded that EUROCROP, during its whole process, examined a large number of issues and that **the complete framework and topics proposals could be used with profit as a suggestions box**, since the order of priorities could certainly be reconsidered in more regional perspectives.

EUROCROP in numbers

- European Commission provided 600 000 € budget
- 26 partner institutions
- 120 experts mobilized at least once, from approximately 100 institutions of different European countries.
- 15 workshops and 8 crop chains reports
- 10 workshops and 6 horizontal issues reports
- 3 Plenary project Advisory Committee sessions in Brussels + 4 coordination meetings
- 4 scenarios elaborated
- SRA structure based on 5 stakes, 36 challenges, 105 goals
- 2 synthesis reports WP2 et WP3 + 1 final report
- 72 research "topics" have been elaborated
- 1final open conference organized in collaboration with the European Economic and Social Committee in Brussels gathered around 60 participants

- 1 web site
- 3 interaction meetings with the Standing Committee for Agricultural Research (SCAR).

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WG2.7 Grain legumes, Anne Schneider, AEP: European Association for Grain Legumes Research, Paris, France (a.schneider-aep(at)prolea.com) / http://www.grainlegumes.com/
WG2.8 Maize: Agustin Mariné, CEPM: Confederacion Europea de Productores de Maiz, Barbastro, Spain (agpmspain(at)terra.es)
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