Madrid, 24 March 2009

***Second Workshop** of the 4FCROPS Project*
Future Crops for Food, Feed, Fiber and Fuel
www.4fcrops.eu

Which are the key future non-food crops in EU27?

The second workshop of 4FCROPS project (organized by INIA and the project coordinator-CRES) carried out in Madrid (24/3/09) in the premises of the National Institute of Agricultural Research (www.inia.es/inia) and the main objective was to indentify the key future non-food crops (fibre and fuel) in EU27.

A total number of eleven presentations were made starting with a presentation from ***Dr. Piero Venturi*** (*EU Commission, DG Agriculture*) that presenting the "Targets of the FP7 Framework Programme for the Agriculture". ***Dr. Efi Alexopoulou*** (CRES), as 4FCROPS coordinator, presented briefly the structure as well as the progress of the project. ***Prof. Melvyn Askew*** (Census-Bio) presented the main IENICA findings that coordinated focused on "Sustainable non-food bio-products: an unexploited opportunity". ***Prof. Luciano Cosentino*** (UNICT) presented which non-food crops have been selected in 4FCROPS as the most important cases in EU27. ***Dr. Katri Pahkala*** (MTT) showed which non-food crops as the most appropriate for northern EU and which of them are being cultivated commercially.

In the second part of the workshop presented some of the most important research projects that carried out in the FP7; ***Prof. Gail Taylor*** presented the project ENERGYPOPLAR (www.energypoplar.eu), ***Dr. Serge Braconnier*** the project SWEETFUEL (www.sweetfuel-project.eu) and ***Dr. Myrsini Christou*** the project Crops2Industry (www.crops2industry.eu).

It was also presented by ***Prof. Jesus Fernandez*** the main findings of the BIOCARD (a project for the perennial non-food cardoon) that supported from FP6 as well as the Canadian project CANOLA by ***Dr. Neil Harker***. Last but not least, ***Dr. Alex Gablenz*** representing the German company ELAION (www.elaion-ag.de) presented the activities of the company on jatropha.

KEY WORKSHOP FACTS

Main findings of the IENICA project about the non-food crops and the follow up

IENICA was an Interactive European Network for the industrial Crops and their Applications (www.ienica.net) completed in 2005 and the main findings were:

- Science and technology were not limiting the uptake of non-food products from bio-resources,
- Massive markets which were significantly under-supplied were indentified and
- A range of non-scientific issues were holding up development.

The main opportunities that indentified from IENICA project were:

- Oil- bio – lubes; bio-inks; surface coating; biosolvents and surfactants; linoleum
- Fibres – Industrial textiles of many descriptions (eg filters; geo-textiles; composites); insulation
- Sugars- massive existing markets in food and non-food sectors. Novel markets in polymers; cosmetics; pharmaceuticals; etc.

- Specialty products – wide and diverse range including pharmaceuticals; pesticides personal care products; OTC medicines; colourants and dyes.

The main constraints in non-food crops development are: a) the government priorities tend to be short and not inter linked, b) industry and the general public is still broadly unaware of the potential of bioresources, c) change involves risk and costs money – stakeholders and investors tend to be averse to these things and d) planner, for example are inhibiting progress.

The main drivers to change this situation are: a) climate change, b) the worries about reliability of oil supply, c) the needs to recycle because of pollution and waste disposal problems, d) the recognition of value of insulation and reduction of oil demand and e) the inter-linkage of science and technology in for example bio-refinery.

Key future non-food crops for EU27 according to 4FCROPS project

A large number of non-food crops have been considered appropriate for fibre and fuel production the last two decades in EU. In 4FCROPS project the non-food crops categorized according the final end use into five groups: a) oil crops, b) starch and sugar crops, c) fiber and cellulose crops d) lignocellulosic crops and e) sugar crops.

For each climatic area in EU27 (Continental, Panonian, Atlantic north, Atlantic central, Lusitanian, Mediterranean north and Mediterranean south) the most promising non-food crops listed below:

- ***Continental:*** Rapeseed, Sunflower, Sweet and Fiber sorghum, Topinambur, Miscanthus, Switchgrass, SRF, Sida ermaphrodita Reed Canary grass
- ***Panonian:*** Miscanthus, Switchgrass, Reed canary grass, SRF
- ***Atlantic north:*** SRC, miscanthus
- ***Atlantic central:*** SFR, Miscanthus, Rapeseed
- ***Lusitanian:*** Rapeseed, Reed canary grass, Miscanthus, Switchgrass, Sunflower
- ***Mediterranean north:*** Sweet and Fiber sorghum, Arundo, Miscanthus, Rapeseed, Soybean
- ***Mediterranean south:*** Brassica carinata, Cardoon, Arundo, Saccharum aegyptiacum, Ampelodesmos, Spartium junceum

List of the non-food for northern EU

The future non-food crops for northern Europe categorized are: a) caraway as a non-food crop, b) energy crops such as reed canary grass, fibre hemp and straw, c) pulping field crops for papermaking and d) dye plants.

Caraway is a biennial crop that is being cultivated in Finland (which is the only producer) in a total area of 20000 ha and its seeds are used as a spice.

Reed canary grass is a perennial grass that can be used as an energy and fibre source in Sweden and Finland and can be harvested for 10-15 annual harvests with yields varied from 3 to 8 dry matter yields per ha. It should be pointed out that Finish Ministry of Agriculture had been set a target for 100.000 ha by 2015.

Fiber hemp have been evaluated for solid biofuels with dry matter yields 6-10 t/ha when the harvesting takes place in autumn and 4.7 to 5 t/ha when it is postponed until spring. A large number of field crops have been tested for papermaking and reed canary grass was chosen as the best because had the highest pulp yield and crude fibre content, lowest kappa number and high crude fibre content indicates high pulp yield.

The main ***dye plants*** that have been tested were: blue dye, dyer's knotweed and tansy.

The climate change will affect the crops that will be cultivated in the north Europe. It should be mentioned that the day length will remain the same.

Poplar as a non-food crops for second generation biofuels

Poplar is being investigated currently in the ENERGYPOLAR project (www.energypoplar.eu) started in 2008. The project is addressing the yield gap in energy poplar in order to produce more biomass on less land. The actual poplar yields in UK are around 10 ODT per ha and the potential yields could reached 35 to 40 ODT per ha.

The main reasons for making poplar as an ideal bioenergy model are: a) full genome sequence, b) small genome, c) diversity of species, d) fast growing perennial, e) clonal, f) transformation system, g) genetic collections and molecular maps, i) activation tagged populations, k) EST and BAC libraries and l) genomic and post genomic tools.

The main aims of ENERGYPOPLAR are: to improve the feedstock characteristics for bioethanol production, to improve yields, to improve saccharification, to improve sustainability and water use efficiency and to optimize the LCA.

Important points of ENERGYPOPLAR: a) the poplar is a crop with high potential as bioenergy feedstock, worldwide, b) the genomic approaches are beginning to unravel complex traits such as biomass, response to drought and c) new research centers in the USA will invest massively in poplar and Europe should aim to remain competitive.

Sweet sorghum a promising annual non-food crop for bioethanol production in EU

Sweet sorghum is an annual crop suitable to be cultivated in EU with high yields for bioethanol production. During the last two decades sweet sorghum has been investigated in some European projects. SWEETFUEL is a European research project (www.sweetfuel-project.eu) that has just starting and aiming to solve the most important bottlenecks of sweet sorghum cultivation.

SWEETFUEL objectives are: a) to breed ne high performance sweet sorghum material that will be adapted to temperate area and will be drought and/or marginal soil in semi arid areas, b) to improve the knowledge on the accumulation of sugars and the relationships among the traits for sugar accumulation, plant phenology, stay-green and terminal drought tool, c) to understand the agronomic determinants of optimized yield and recommended the best cultural and harvest techniques, d) to elaborate a plant model for sorghum to indentify potential area for production, e) to provide a multi-criteria evaluation of the sustainability of the bioethanol production from sweet sorghum on a social, economic and environmental point of view, f) to indentify and monitor of the ethical risks due to the development of ethanol production from sweet sorghum and propose guidelines for policy makers.

In the view of this project sweet sorghum field trials will be established in France (Montpellier) and in Italy (Bologna).

Crops2Industry a new project for connecting the non-food crops with Industry

Crops2Industry is a new European project having as overall objective to explore the potential of non-food crops, which can be domestically grown in EU27 context, for selected industrial applications namely oils, fibers, resins, pharmaceuticals and other speciality products and outline and prioritize crops-to-product schemes,

suitable for the different Member States, which will support sustainable, economic viable and competitive European bio-based industry and agriculture.

Crops2Industry is a coordination and support action project that will start in September 2009 and will organize five thematic workshops in order to collect as much information as possible to fulfill it main aim. The titles of the workshops are: 1) Can the fibre crops offer a viable alternative land use option, 2) Niche markets for speciality industrial crops, 3) can oil crops be considered as the only industrial crops that have a clear niche market in EU27, 4) Carbohydrate crops and the dilemma of using them for non food purposes and 5) Non food crops for a biobased industry and sustainable agriculture.

A very important element of this project is the participation of four industries (the consortium is consisted from 14 partners) that will be responsible for the four out of the five thematic workshops.

Cardoon a perennial non-food crop for the South Europe with many industrial applications

BIOCARD was a project funded under the FP6 (completed in November 2008) that dealing with the promising non-food crop cardoon for the South Europe that has several industrial applications.

In this workshop presented only the work that had been done for the management and the harvesting of the crop. In BIOCARD six topics were investigated: a) cynara biomass productivity, b) cynara oil production, c) development of a static system of biomass fractionation from bales to seeds and lignocellulosic biomass, d) development of specific machinery to harvest and separate directly in the field the seeds and the biomass, e) analysis of low cost pre-treatments for cynara biomass and f) cynara biomass logistics.

Cynara was established in a 20 ha field in Madrid in a very bad soil that were also not homogeneous. In fields under favorable conditions (500 mm precipitation/year, deep soil and loam texture) 14 t/ha dry matter yields could be obtained. The harvested biomass (in summer) contains: 37% basal leaves, 11% cauline leaves, 21% stems (stems+ braches) and 31% heads. It has been estimated that about the 8.7% of the total harvested biomass are oil seeds. The seed production was 1.2 seeds per ha and the seeds contains 25% oil. The fatty acid profile of cynara oil is similar to common sunflower oil.

Two harvesting systems were studied: a) harvesting the whole crop and b) harvesting separately the capitula flowers and the rest aerial part. Losses of seeds recorded if conventional harvesting machinery for cereals is used. It was decided to separate the capitulas from the stems on the field. Two cutting heads in the harvests: the upper for the capitulas and the lower for the stems.

Canola for biodiesel production in Canada

Canola is the number one cash crop for biodiesel production in Canada. Nowadays, research on this crop is being carried out through the Canadian CANOLA project (2008-2013). Dr. Neil Harker presented the first year results of the Canadian Canola project. It should be stressed out that the 95% of the cultivated canola varieties have been genetically modified.

In 2008, 10.9 million tones of canola were produced from a total area of 6.4 million hectares. It is estimated that there will be a demand for 15 million tones of Canadian canola by 2015 and 2.5 million tonnes will be the demand for biodiesel feedstocks.

It should be pointed out that in this project field trials will be carried out for a period of six subsequent years in several sites of Canada and in all cases rotation study will be made. Recently some diseases were recorded in the canola fields.

Canola in Canada had been compared with other 10 crops and canola was the best. The ten crop species that were compared are: argentine Canola LL hybrid 5440 (Brassica napus), Polish Canola synthetic (Brassica rapa), Camalina (Camelina sativa), Ethiopian mustard (Brassica carinata), Yellow mustard (Sinapis alba) Andante, canola quality Juncea (Brassica juncea) cutlass, flax (Linum usitatissimum) CDC Bethune, soybean (Glycine max) – variety 1, soybean (Glycine max) variety 2.

Jatropha cultivation for biodiesel production

Jatropha is a perennial crop that recently has been selected as an excellent source for biodiesel production The German Company Elaion (www.elaion-ag.de) recently rent a total area of 1,000 ha in Mozambique (from the government) for a total period of 50 years. The rent area is open woodland savanna and charcoal being the main ecosystem service. Elaion Company is trying to cultivate this crop in a sustainable way and trying by cultivating jatropha on these fields to go from degrading marginal areas to sustainably cultivated areas. Jatropha is being used for fire protection in high conservation value areas and offer land and income opportunity for relocated dwellers.

The main crops applications are: fertilizers, biochar, soap, fuels, lubricants, pesticides and base materials for chemicals. It has been tested to mix different oils from seeds, vegetables or algae, in order to optimize the desired characteristics. Biological additives have been used to enhance oxidation stability and pour point.

One of the main cultivation problems of this crop is the no uniform ripen of the crop and this mean that it is very difficult to be harvest in a specific time of the year. There is no mechanical harvesting of the crop, although some machines from other crops are being tested (like machines that being used for olive oil trees). At the moment is being harvested by hand and for this reason jatropha is a crop that can be cultivated only in the low cost labour countries.

The main problems for the cultivation of jatropha in Europe are: a) it is not resistant to cold and b) there is no mechanical harvesting.

Round table discussion

During the round table discussion several questions were raised that the most important were:

why you the non-food crops that you presented today, the choice of the crops driven by Government or by research, how easy the farmers convinced to change their cultivation, which non-food crops will exist in EU27 agriculture after ten years (climate change should be taken under consideration), what about genetic modified crops (GMO), is any available agricultural land for the cultivation of non-food crops and why there is only a small amount of money for research on crops from DG Research under the 7th Framework Programme.