IENICA

Newsletter number 4 August 1998

'Hemp for Europe, Manufacturing and Production Systems': European Shared Cost Action

Hemp (*Cannabis sativa* L.) is an industrial crop mainly grown for fibre. It produces over 25% more long fibre than flax and is better adapted to the temperate climate of Europe than kenaf. Overall stem content is about 75-80% of which 35% are long bast fibres. Hemp is a multiple purpose crop, suitable for the production of products like quality paper, boards and panels, composites, textiles, geo-textiles, wovens and non-wovens, animal bedding, vegetable oil, and seeds. It is being evaluated to replace glass fibre.

The EU-FAIR shared cost action 'Hemp for Europe, Manufacturing and Production Systems' (PL95-0396) reflects the European Commission's interest in this industrial crop. Within this action – running from 1996 until the end of 1998 - there are three main research areas involving participants from five European countries. Its focus is on the production and the use of fibres.

The primary production research in the project focuses on breeding of new cultivars, developing best cultural practices and testing these at field scale. Breeding of cultivars of very low levels of psycho-active compounds is a prerequisite from the legislative point of view. Selection of lines on the basis of nematode resistance is also being undertaken. With respect to the agronomy of the crop, current cultivars and cultural practices have mostly been developed in Central France, based on the production of seed and fibre. However, at more northern latitudes crop maturity is delayed by the longer days, making production of fibre more effective than that of seed. In Southern Europe the contrary is the case, making circumstances more beneficial for seed production. The final aim of the agronomic research in the project is to optimise hemp yields and quality, by formulating the optimal combinations of cultivar, crop management techniques and harvest date. Development of a crop growth model will enable husbandry decisions to be tailor-made for any given production environment.
Within the area of Agro-technology, time of harvest in relation to fibre quality is being investigated; specialised machines that are adapted to harvest different crop components (stem, seed) are being developed, and a novel device is under study for potential application in hemp processing. As mechanical extraction of fibres (decortication) can often lead to a reduction in fibre quality, alternative extraction methods like steam explosion and ultrasound treatment are being tested.

The current major use of hemp fibre is in the production of speciality papers. However, to be successful in the other applications specified above, more basic knowledge is required on chemical and/or physical treatment of fibres, the resistance and matrix compatibility of modified fibres and the characteristics of the end products made out of fibre. This research is done within the area of Industrial Products.

It is envisaged that the project will contribute to an increased cultivation and industrial use of fibre hemp. This non-food crop provides arable farmers with a productive alternative to set-aside. The crop is environmentally friendly, with a minimal requirement for agrochemicals. The products manufactured from it are biodegradable and renewable.

These positive traits of hemp may allow this crop to play an important role in the future Framework-V programmes on non-food crops. The 'Hemp for Europe' shared cost action can thus be seen as a first appraisal of the potential of this crop. Therefore, wide dissemination of the project results to all who are interested is important. Progress on this point will be reported in the IENICA newsletter.

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European Agro-Industrial Research and Results from the Eclair Programme

The Second EU Research and Development Framework Programme included Action 4 "*Exploitation and optimum use of Biological Resources*", with a sub-action 4.2 specifically for "*Agro-Industrial Technologies*". Sub-action 4.2 consisted of two specific programmes called **ECLAIR**, standing for "European Collaborative Linkage of Agriculture and Industry through Research" and **FLAIR** "Food-Linked Agro-Industrial Research". The EU contribution to the budget for the ECLAIR and FLAIR Programmes was set at 105 MECU representing 2% of the total of the Second Framework budget.

The ECLAIR programme was specifically set up to apply new technologies such as biotechnology and information science to the agriculture and fisheries business sectors through the format of shared cost European co-operative research projects. The first call for proposals for the ECLAIR Programme was launched on 17 December 1988 with a 31 March 1989 deadline. The 220 proposals received request funding of up to 400 MECU from the Community, or 57% of the total cost. Around 1,410 participating institutions, made up of industries, public and private research institutes, and universities, responded. After the evaluation of the proposals by independent European experts, 42 projects were selected for funding involving 334 participants. Of these 104 or 31% were industrial partners (75% SMEs), 130 were universities, and 100 were from research institutes. The high industrial participation was due to the fact that industry was strongly encouraged to participate and an active industrial involvement in the proposal was a pre-requisite for selection.

Of the overall 104 industrial participants 75% were SMEs, **which was the highest SME participation rate in a specific programme within the Second Framework initiative**. These SMEs for the main part were high technology companies, many of them dealing with the application of biotechnology in relation to germplasm, disease control, diagnostics, and instrumentation. By their own admission the competitiveness of these SMEs was significantly enhanced by participation in the programme, through access to, and direct use of, leading scientific researchers, and facilities, in the public and university research domains. The ECLAIR budget for the 42 selected projects amounted to 65 MECU and a typical project had 8 participants, lasted for three years, had a total cost of 3 MECU, and an EC contribution of 1.5 MECU. All twelve member states at the time participated, with notably high participation from the smaller countries, and from the Mediterranean regions.

Many specific market areas can be identified in which the technological basis of the agro-industrial sectors and consumer interests have been enhanced by the ECLAIR research programme. Examples include the forestry, seed, food and drink, chemical, and biotechnology industrial sectors.

The ECLAIR programme was instrumental in attracting leading scientific expertise into the projects for specific industrial applications. This unique type of European funded cooperation enabled both SMEs and large companies, working in collaboration with leading academics, to advance their competitiveness in their selected strategic areas through the development of new products and processes emanating from the programme. **Furthermore, EU sponsored collaborations between industry and the European agro-industrial science base were established for the first time** and these linkages and networks have been further enhanced and developed in the subsequent framework programmes AIR and FAIR. The diverse range of projects found in the ECLAIR programme necessitated their grouping into the following four levels: **LEVEL I Crops and Trees for Non-Food uses; LEVEL II Crop adaptation and Food Processing; LEVEL III Animal Health and Aquaculture; LEVEL IV Biological control of pests.** The results of these projects are described in a recent publication entitled "ECLAIR final results"(EUR 19952 ISBN 92-826-9712-6)

The quantifiable impact of the ECLAIR programme on European Agro-Industrial research is hard to measure as it has touched upon so many diverse markets, and many of the projects were from the onset quite upstream in their research objectives. **One can mention however the 40 patent applications, the 200 scientific publications, the 10 commercially available products, the 42 European agro-industrial networks created, as an overall measure of technical success.** Its resounding strategic success on the other hand has been in realising the initial objective of the programme in demonstrating on a European level the potential of generic technologies as applied to the important business sectors of animal health, pest control, food technologies, seeds, and the chemical and paper pulp industries. The application of modern biotecnological techniques and information science was an important element in almost every project and it has helped bring many fledgling ideas from the laboratory to a pilot scale or near market scenario. It has also demonstrated to the European consumer the high

level of expertise available across Europe to provide a new range of sustainable industrial and food products and processes from Europe's most abundant resource, renewable biological materials. In relation to non-food applications, and biotechnological deployment, many non-technical barriers still need to be breached especially in the domains of consumer acceptance and supporting policies and legislation. ECLAIR has shown that European agro-industrial research has a tremendous potential to develop new products and processes from new technologies from biological resources, and to generate employment and increase European competitiveness.

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Commercial-Scale Production of Woad-Derived Indigo for Industrial Use.

Changes in legislation and a growing demand from consumers and manufacturers for naturally-derived products from renewable resources, have led to a revived interest in the production of chemicals from plants.

Nowadays, most of the colours used in commercial textile dyeing are synthetic. They are synthesised, by various means, from by-products of fossil fuels, e.g., aniline and other aromatic derivatives, but this has not always been the case. Until the turn of the century all colour came from the natural world, as there was no other means to derive it. A recent CEC-funded project which looked at three major dye-crops, woad (indigo), madder (alizarin) and weld (luteolin), has shown that the production of natural dyes is possible on a commercial-scale using modern farming techniques. This has led to a need for new, industry-led, research on these crops to apply twentieth century agricultural methods and devise large-scale extraction methods to maximise their potential.

If natural dyes are to be reintroduced into the market place, then indigo provides an ideal starting point, as there is already an existing demand for the final product, viz., its use in dyeing denim jeans. As a consequence, its importance in world terms is still immense, such that, of an international dye market of 800,000 tonnes, one tenth is contributed by indigo. However, natural indigo accounts for less than 1% of the total indigo market.

The earliest known source of indigo was *Isatis tinctoria* (woad), a biennial or perennial herb, indigenous to northern Europe. It belongs to the the Cruciferae family and shares many phenotypic similarities with them. Indigo is not produced directly by woad, it is derived from two indoxyl forming substances found in its leaves, indican and isatan B, which, when exposed to the air form the blue compound, indigo.

A crop of woad growing in the U.K.

Historically, woad was grown commercially in Northern Europe until the 16th century and was a common-place crop right through until the 18th century. Because of foreign imports of tropical indigo, mainly from India, it ceased to be grown as a crop in the middle of the 18th century. However, it was still grown on a small-scale, as woad indigo was mixed with imported indigo in the dye vats to improve the fermentation process. As a consequence, there has been no attempt to breed woad to improve indigo precursor content or crop architecture.

Currently, small amounts of naturally-derived indigo are produced in tropical and sub-tropical countries, from various indigo-producing plants. This source provides enough indigo to satisfy the demands of small-scale craft dyers, supplying exclusive markets. These supplies vary widely in quantity, e.g., between 1988-1993, exports from India fluctuated from 2 to 20 tonnes per annum and no standards are in use to guarantee quality.

A three year project to study woad has been funded in the U.K. through a LINK programme between academic partners (University of Bristol and Silsoe Research Institute) and industry, by the Ministry of Agriculture Fisheries and Food (MAFF) who have contributed almost £300,000, which has been matched by £400,000 from the private sector, viz., Willett International Ltd, Gorham and Bateson (Agriculture)

Ltd, Agrifusion Ltd. The objectives of the work are to grow woad on an agricultural-scale, using modern farming techniques and this will be coupled to a breeding programme aimed at producing a greater yielding and stable variety of the crop. The woad will be harvested using a specially designed harvester and the indigo precursors will be extracted using a process devised in a feasibility study, funded by the EC. This process is much more efficient than that used in the past and much cleaner. Ultimately, the project will result in the development of a commercial-scale extraction plant. At the instigation of the industry involved, based on the demands of consumers for more environmentally-friendly materials, the end product, indigo, will be used in the manufacture of water-based, bubble-jet inks for computer printers.

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Forthcoming Industrial Crops Events

28 - 30 Sept 1998
Bast Fibrous Plants Today and Tomorrow
St Petersburg, Russia
Cultivation, Breeding, Molecular Biology and Biotechnology of Flax and Other Bast Plants.
Contact: Maria Mackiewicz-Talarczyk
Institute of Natural Fibres,
ul. Wojska Polskiego 71b,
60-630 Poznan, Poland.
Tel: + 48 61 82248 15; Fax: + 48 61 8417830
Email: netflax@iwn.inf.poznan.pl
Internet: http://iwn.inf.poznan.pl/~netflax

27 Sept - 1 Oct 1998
Plant Proteins in Abiotic Stress
Responses: Function, gene regulation and industrial applications
Plant Protein Club, University of York
PO Box 373, York YO10 5YW, UK
Tel/Fax: +44 (0)1904 434327
Email: ppc@york.ac.uk
www.york.ac.uk/org/ppc/contact.htm

7 - 9 Oct 1998
Crops for a Green Industry
Gmunden, Austria
Contact: Ms Sonja Mayer/Ms Irene Baumann
CFI, Congress and Fair International,
Wasagasse 6/12, A-1090 Vienna, Austria.
Tel: + 43 1 310 20 07
Fax: + 43 1 310 20 09
E-mail: cfi@eunet.at
Internet: http://cfi.austrian.org

19 - 20 Oct 1998
Boosting the Market for Bioenergy in Europe
Herning, Denmark.
Contact: Green City Denmark A/S, Merkurvej 910,
DK-7400 Herning, Denmark.
Tel: + 45 97 21 64 00. Fax: + 45 97 21 74 21
Email: info@greencity.dk

21 - 22 Oct 1998
Second European Panel Products Symposium
Llandudno, Wales, UK.
Contact: Ms. Sue Griffiths
University of Wales - Bangor
The BioComposites Centre
Gwynedd LL57 2UW, UK
Tel. +44 (0) 1248 370588; Fax +44 (0) 1248 370594
E-mail: r.s.griffiths@bangor.ac.uk
Internet: http://www.bc.bangor.ac.uk/announce.htm

4 Nov 1998
Sustainable Surfactants - Renewable Feedstocks for the 21st Century
Central Science Laboratory, York, UK
Contact: Nicholas Grayston or Sue Armitage
Alternative Crops Unit, Room 401 WPE
10 Whitehall Place, London SW1A 2HH, UK.
Tel: + 44 (0) 171 270 8323 Fax: + 44 (0) 171 270 8607
Email: iecrops@gtnet.gov.uk
Internet: http://www.maff.gov.uk/farm/acu/acu.htm

For further details of the industrial crops events see the IENICA database: www.csl.gov.uk/ienica

The IENICA project is funded by DGXII of the European Commission under the FAIR programme. IENICA involves 14 states in the EU.

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