epobio newsletter

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Realising the economic potential of sustainable resources – bioproducts from non-food crops

Editorial

Welcome to the third EPOBIO Newsletter. In our earlier Newsletters we set out the background to EPOBIO and details of how the Project will work. In Newsletter 3 we aim to provide a 'snapshot' of the current state-of-play covering the various activities which have evolved from the discussions, ideas and suggestions from the Workshop held in Wageningen in May 2006, which have been taken forward in our Flagships and Support Themes.

First Workshop Final report

The final report from this meeting has been printed and is being dispatched to Workshop attendees, Advisory Board members and research funders in the EU and candidate countries. Unfortunately, the number of printed copies is limited by constraints of the budget. However, it is available to all as a PDF file that can be downloaded from the website:

Final Report from the Workshop (287 Kb PDF)

If you feel a printed copy is essential for your work, contact us and we will distribute these on request on a first come first served basis.

Flagship Progress

As indicated below, during the four months since the workshop good progress has been made and work is on track to deliver the first formal reports by the end of October 2006. As is our aim in EPOBIO, those reports will integrate the technical aspects covered by the Flagships with the activities of the Support Themes. This process will validate decisions to develop products and processes through analyzing their environmental impacts, the economic issues and the social attitudes of the public towards development. The summaries below indicate current (early September 2006) thinking but are by no means conclusive at this stage, with all of the studies on-going. We present these interim views, along with an invitation for your input which will assist us as the ideas are consolidated to generate the overview reports in October.

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Public Opinion Survey

One of the activities of the support themes is to monitor the attitude of the public to the use of crops for non-food purposes as well as to establish to what extent the use of genetically modified (GM) crops is found acceptable. As described below in more detail these questions are being addressed through a telephone survey within selected Member States using standard statistical selection of interviewees which will cover 600-800 people across 10 countries during October 2006. We would also welcome a more general response, hence a Social Attitudes Survey has also been added to the website and we would appreciate it is you could spare a few minutes to add your opinions using the on-line version. The online survey will remain available until Friday 17th November; results from the online survey (which is expected to attract more scientists and those already involved in non-food activities) will then be compared with those from the telephone survey.

Information dissemination

The design changes undertaken to bring the structure of the BioMatNet site (http://www.biomatnet.org) in

line with that of the EPOBIO site have been completed. The Database of Websites has also been updated, with further sites being added on an on-going basis. We are pleased to accepted suggestions for further additions, especially from the USA, the more recent members of the EU and indeed from around the world.

Second EPOBIO workshop

Preparations are now in hand for the second EPOBIO workshop to be held in Greece in the week commencing 28 May 2007. Details have yet to be finalized but we expect 200-250 delegates to attend the workshop and that feedback from the 18 months work in EPOBIO Flagships, cross-cutting issues (environment, economics, social attitudes and communications) and options for next generation Flagships will be part of the programme.

We trust you find this a useful indication of the continuing activities within the project and welcome comments or other inputs.

The EPOBIO Management Team

Project Progress – Flagship Themes

Cell walls

The first investigation of research needs investigated within this area of activity looks at the possibilities investigation of improving the efficiency and reducing the cost of a key generic process in cell wall biorefining. This process is saccharification, the conversion of biomass into C5/C6 sugars - essentially, the digestion of plant cell walls (Fig 1). This aspect underpins the development of the subsequent work for the Flagship, since the nature of the processes chosen for saccharification determines the range of materials and value of products that can also be derived from the input to the overall process.

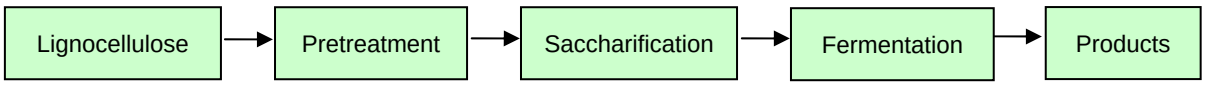

Figure 1: Generalised lignocellulosic conversion process.

Current and future European and US research initiatives in the area of cell wall biorefining have been reviewed. A major research project in the field of ethanol production from lignocellulosics is the European project New Improvements for Ligno-cellulosic Ethanol (NILE). It aims to develop cost effective production of ethanol from lignocellulosic biomass.

In the US, the Department of Energy (DOE) has established the Biomass Program, aiming at reducing the dependence on foreign oil by developing biomass based liquid fuels and to foster the domestic biomass industry. Recently, the DOE announced that it will establish one or two new bioenergy research centres that will focus on developing the science for biofuel production. The Centres will be funded for up to US$125 million over a period of five years.

One reason for the interest in using lignocellulosic biomass as a source of sugars that can be used as raw material for the manufacture of products, especially ethanol, is to reduce the use of fossil resources. The displacement of fossil fuels with biofuels will reduce energy dependency on oil and provide positive environmental benefits such as reduced carbon dioxide emissions. The utilization of plant cell walls for the production of biobased products could contribute to a more sustainable future of our planet.

During the first EPOBIO workshop the need for the development of bench-based micro-assays to determine cell wall characteristics, e.g. cellulose crystallinity, that can be used to screen different sources of biomass, was identified. In combination with assays determining the digestibility of the feedstock such studies can advance our understanding of the factors influencing cell wall digestibility. Such investigations should help determine which cell wall characteristics influence digestibility.

Participants at the EPOBIO workshop recognised the importance of and need to determine the structure of native cellulose as it is present in the cell wall. The stereochemistry of cellulose and the association of microfibrils with other components, such as lignin and non-cellulosic polysaccharides, have to be examined. It is of importance to study these characteristics on a

wide range of biomass samples from different species and varieties. The impact of various techniques used in pre-treatment has to be evaluated. A matrix of various pre-treatment techniques linked to the use of alternative enzyme hydrolysis protocols will help define optimal process conditions for a given feedstock. In addition it was concluded that a screening method for determining the digestibility of different feedstock is needed and can be used to help identify suitable biomass for breeding programmes.

The second research need that is being investigated within this Flagship is the need for the development of small scale digestibility assays. These are needed to carry out high-throughput analysis of biomass samples and for the assessment of the effectiveness of novel hydrolases.

Plant oils

The Plant Oil Flagship breakout session at the EPOBIO workshop in Wageningen was focused on identifying oleochemical-based products and related research and development necessary for their commercialization. It was agreed to first develop a roadmap of the research and development needed for a plant production system of wax esters for use in lubricants. This newsletter flash gives a brief introduction to the ongoing work that will result in the first plant oil product report.

Lubricants are vital for engines and machines to work properly; their main function is to reduce wear and heat between two sliding surfaces. This is achieved by inserting the lower viscosity material of the lubricant between the two surfaces having a relatively high coefficient of friction. The importance of well suited lubricants is shown by the US Department of Energy's calculations, estimating that reducing friction and wear in engine and train components could save the US economy up to $120 billion per year. Lubricants comprise a huge market that is currently dominated by petrochemical-derived products, although plant-derived oleochemicals also contribute to a small portion of this market.

The lubricating properties of a material are determined by certain specific characteristics. Interestingly, vegetable oil provides many of those desirable lubricating properties and therefore has a good chance for increased use in lubrication, thereby replacing mineral oil as feedstock. That is, if ways of manufacturing them can be price competitive. Two major limitations with plant oils are the thermal and oxidation instability which needs to be improved by chemically or genetically modifying the plant oil and/or by using additives. Examples of such additives are wax esters, compounds that are made by reacting an alcohol with a fatty acid. Even though 'synthetic' esters, including wax esters, can be made from plant oils by chemical processes, they are primarily produced from mineral oils. However, the dwindling reserves and the rapidly increasing price of petroleum coupled to the environmental problems associated with its use have evoked a growing interest in switching into renewable based industrial feedstocks.

An attempt has been made to identify the different areas of importance in the development of new wax esters from plants in a competitive market. Petroleum based feedstocks are, in general, strong competitors since they have a relatively low price and excellent lubrication properties can be obtained by advanced organic chemistry. A critical part of our study is therefore to define the research areas that need to be developed in order for the new wax esters to meet the target levels of price and property qualities set by the products on the market.

An important general consensus at the EPOBIO workshop was the need for special transgenic oil crops devoted to the production of industrial feedstocks in order to minimize the risk of contaminating the food production chain. We have therefore started to examine what is needed to develop the industrial crop *Crambe abyssinica* (Crambe) into a reliable producer of such new wax esters.

Figure 2: Crambe flowers (left) and seeds (right).

For the report, several areas have been outlined and are presently being examined. These include:

- What characteristics are important in order to make such new biobased wax esters competitive?

- What gene discoveries and biotechnology inputs are needed in order to assemble a production chain of specific wax esters in Crambe?
- Which agronomic properties need to be improved in Crambe in order to yield optimal oil quantity?
- Which are the necessary processing technologies for the production of Crambe oil and how do they need to be improved?
- How can by-products from the oil extractions be developed for optimal economy?

One difficulty in this work is to estimate the price of a new wax ester that yet has to be produced by a system that still has to be developed. One way is to investigate the present systems for producing wax esters (Fig 3) and calculate the cost for these production routes and thus the price of the finished wax esters.

Conventional chemical processes are presently the dominating method to produce synthetic esters such as wax ester. These processes are associated with several disadvantages of which some can be solved using enzyme technology in non-aqueous systems. An alternative production is the one we are pursuing, using high yielding oil crops that have been genetically modified to produce high performance wax esters.

This information will give the target level of the price for the wax esters that will be produced in Crambe. This target price for Crambe produced wax esters will be guidance for identifying the different areas where research and development are needed in order to increase the price competitiveness for plant produced wax esters. This evaluation can for example lead to conclusions such as: oil content has to be at least X% rather than the present 30%, yield has to be the minimum of Y ton/Ha than the present 1.5 – 2.5, long chained fatty acids has to make up more than Z% of the oil than the presently 50%, and so forth.

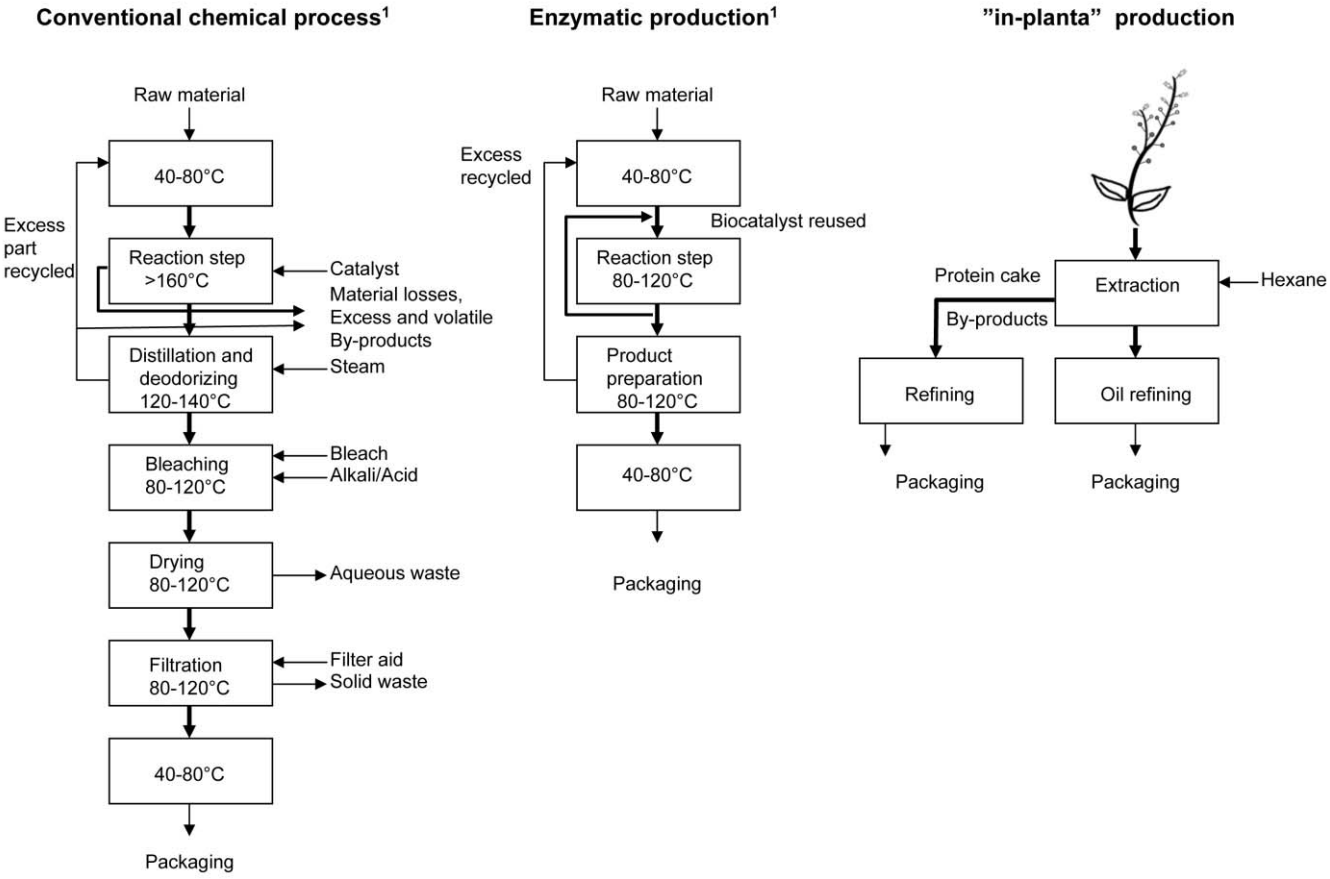

Figure 3: Present systems for producing wax esters. Source: G. Hills, Industrial use of lipases to produce fatty acid esters, Eur. J. Lipid Sci. Technol., 2003, 105 (10), 601-607.

Biopolymers

The first project investigated by the biopolymer Flagship is aimed at the development of alternative sources of natural rubber obtained from the rubber tree (*Hevea brasiliensis*), an essential biopolymer that cannot be replaced by synthetic equivalents in applications like heavy duty tires.

After a low point in 2000, the price of natural rubber increased 5-fold, and is now extremely volatile due to a slowly developing shortage. Accidental spread of the fungal disease South-American leaf blight (SALB) to South-East Asia could reduce production by millions of tons practically overnight, which would drive rubber prices through the roof. While SALB is a basically a strategic issue, it is more likely however, that a pressing need for additional rubber supplies will develop based on strong Asian demand. Furthermore, in the long run it will be necessary to replace oil-based synthetic rubber by renewable materials.

One alternative to the rubber tree exists that has actually been a true competitor in the past: a Mexican shrub named guayule (*Parthenium argentatum*). This grows to an average height of around three feet producing natural rubber latex in its bark. The "variety protected" line of domesticated Guayule, illustrated here reaches maturity in two years with high-latex yields.

Figure 4: Left: A newly planted field of guayule, Right: An established field of guayule. Photographs from the Yulex Corporation (http://www.yulex.com) 11 April 2006, provided by Dr. Katrina Cornish, Senior Vice President, Research & Development, Yulex Corporation.

In 1910, guayule provided half of the natural rubber imported in the US. However, expensive processing, and increased competition from rubber tree plantations led to the end of commercial production in Mexico in 1945. During the 20 th century interest in guayule was revived several times for strategic reasons. The American company Yulex is presently commercializing the production of Guayule rubber latex because, unlike Hevea rubber, it doesn't cause type 1 allergic reactions in, for example, medical applications. Although precise data are lacking, guayule rubber is apparently not currently competitive with hevea rubber for more general purposes. To identify the most pressing research needed to make guayule a competitive crop, the scientific literature as well as reports by research institutes and commercial enterprises has been searched.

Although guayule has a history of over a century of testing and development in Mexico , the US , South Africa , Australia , and several other countries, it is considered only partially domesticated. Many lines were lost when earlier research programs were terminated, and the remaining germplasm is quite narrow. Although yields of a 1000 kg/ha/y of guayule rubber are possible, most studies report between 300-600 kg/ha/y. Soil requirements and optimal irrigation regimes are not well investigated. It is also not yet clear whether it is best to harvest the entire plant after 3-5 years, or whether the plant should be pollarded once or several times. Storage is also not trivial, as baling the entire shrub takes up too much space. Chipping the plant material reduces the volume, but exposes the rubber to oxygen, causing rubber chain degradation. To prevent this, an antioxidant must be added.

Presently, the most thoroughly evaluated processing method is the one step solvent extraction developed by Bridgestone/Firestone. In this method, both resin and rubber are extracted simultaneously using a mixed solvent. Consecutive precipitation steps yield high MW rubber, low MW rubber, and resin. The bagasse remaining after extraction is the most significant co-product, and the final ratio these four products is about 9:1:10:100. It is difficult to judge the economics of the process as details have not been disclosed. It is clear though that uses for the co-products must be found to make guayule cultivation economically viable.

Other alternative sources to Hevea rubber are also being considered. The most promising is the Russian dandelion, which produces rubber of the same quality (chain length), but is difficult to cultivate. The issues briefly discussed above are also relevant to the Russian dandelion, except that much less work has been done on this plant.

In almost all issues (be it for guayule or for Russian dandelion) there appears to be a considerable difference in opinion - or even clear controversy - on best practices, indicating that much remains to be done. Moreover, our limited understanding of genes, proteins and metabolic pathways involved in rubber synthesis is quite astounding in view of the tremendous importance of natural rubber for modern society.

A first conclusion of this project is that there is clearly a great potential for improvement of practically all aspects of natural rubber production from alternative sources: from breeding, agronomics, processing, co-product valorization, and applications.

Project Progress – Support Themes

Public perception

The central aim of the "Social Attitudes and Expectations" Support Package, is to identify public opinion and to predict the social reception of the novel products proposed by EPOBIO Flagships. It has primarily focused on the issues involved in the implementation of empirical social research with Public Attitudes investigated by means of a telephone and online survey. The survey questionnaire is focused on the Flagship priorities but also looks at attitudes to industrial uses of crops, attitudes to GM and attitudes to GM in an industrial use context. This method offers the opportunity to generalize from samples to national populations. Hence, the survey results should map the dynamics and variations of public perception across European countries as well as enable comparisons to be made between them.

The questionnaire has been designed in such a way so that it provides issue-specific information and to relate this to the general characteristics of the public. Specifically, it consists of two parts: one to measure demographics and general attitudes towards science and technology and one to identify attitudes towards the industrial uses of crops for several applications and issues involved. The latter section comprises the core of the questionnaire and includes some additional items, such as policy making priorities and trust in key players involved.

The following ten European countries will be surveyed: Bulgaria, Czech Republic, France, Germany, Greece, Italy, Netherlands, Poland, Spain and UK. Fieldwork undertaken in all countries during October 2006 is carried out in cooperation with national universities and sampling agencies. Interviews will take 10-15 minutes and will be conducted via the telephone.

The data obtained will be weighted and analysed. It is estimated that the results will be available by the end of November 2006. Results will be matched with to the main products and processes proposed by the Flagships and will be incorporated into each sectional reports. New Flagship priorities and emerging projects will be evaluated from a social perspective using the same approach, so that the data collected in all stages will be comparable and will be analysed under a coherent framework.

The questionnaire is also available in a slightly extended form on the EPOBIO website. You are encouraged to participate in this survey and complete the exercise online. This should take less time than the telephone survey so if you have 5 to 10 minutes to spare we would appreciate your response. We have extended the time period for the on-line survey to Friday 17th November and will process the results of this survey independently of the phone survey. This approach is expected to highlight possible differences between 'public opinion' and the views of those responding online, since many of the online responses will come from those who receive this newsletter and who thus have already expressed an interest in the development of new of bio-based products.

Take the online survey:
http://www.epobio.net/0610questionnaire.htm

Economics

The research within the economic support package is of course dependent on the decisions made by the respective Flagships. Following on from the first workshop, this has focused on the production and processing costs for Crambe (plant oil flagship) and Guayule (biopolymer flagship). Particular attention has been paid to the potential uses of by-products generated during processing of these crops. Further research regarding these non-food supply chains will examine the optimal scale of the production facilities and identify suitable climate regions in Europe for production of Guayule. To analyse the competitive market potential, existing or improved EPOBIO technologies will be integrated in the ENFA model [1]. Currently, this model contains a detailed representation of the more traditional European agricultural and forest sectors, including estimation of carbon sink opportunities.

Crambe

Microeconomic data were collected for production of Crambe. These data include seed prices, labour, energy, and capital requirements for soil preparation, planting, fertilization and plant protection, harvesting, transportation, and milling [2]. In addition, market prices for Crambe based plant oils were researched. To make Crambe competitive, oil yields and oil composition need to be improved. The determination of the minimum improvement necessary to break even with other oil crops is one of the major objectives for the economic support package as an input to the industrial oils flagship.

Guayule

Economic data were collected for the production and conversion of guayule into natural rubber. Currently, Guayule contains between 5 and 17 percent rubber [3], which must be extracted in a special processing plant. If this concentration cannot be substantially increased, a large amount (~80%) of additional plant material will be delivered to the processing plant. Turning this additional material into useful by-products is therefore crucial for making Guayule based rubber economically viable. Potential by-product uses include conversion into energy (electricity and heat), synthetic fuel (Fischer-Tropsch or biomass to liquid), bioethanol, or biobutanol. These by-product options reduce processing costs because transportation costs for the raw Guayule plant material can be compensated by revenues from by-products.

By-product biofuels

Research on bioethanol conversion showed that the involved distillation of ethanol is relatively energy and cost intensive with a small reduction potential in the foreseeable future. Recent advances with Acetone-Butanol-Ethanol (ABE) fermentation and extraction [4] offer an interesting new alternative. The energy and cost savings of newly developed pervaporation technologies make Butanol superior to Ethanol and competitive to common gasoline. Suitable feedstock for Butanol conversion includes agricultural waste (straw and other cellulosic or sugary biomass).

Notes:

[1] More information available online at: http://www.uni-hamburg.de/Wiss/FB/15/Sustainability/ENFA/

[2] Data were collected from various sources documenting previous European field trials. Numerous German activities are summarized in Krambe – eine alternative Sommerölfrucht (Crambe – an alternative summer oilseed) IN: Schriftenreihe "Nachwachsende Rohstoffe" published by the German Federal Ministry of Food, Agriculture and Consumer Protection, 2001.

[3] Jasso de Rodriguez, D., J.L. Angulo Sánchez, F. Ramirez Godina, R. Morones Reza, and R. Rodriguez García. 1993. J. Am. Oil Chem. Soc. 70:1229-1234

[4] Huang WC, Ramey DE, Yang ST, “Continuous production of butanol by Clostridium acetobutylicum immobilized in a fibrous bed bioreactor.” Applied Biochemistry and Biotechnology 113: 887-898, 2004.

Environment

As a first action the environmental support package developed a process flow-diagram for Guayule covering all aspects from the crop production to the end of life of Guayule rubber used in both tyres and medical products. This flow diagram encompasses all stages of the production chain that have to be addressed and can serve as the template for environmental and economic studies. To evaluate the environmental sustainability of Guayule for rubber production, a life cycle analysis (LCA) will be performed in close cooperation with the economics support package. To perform an LCA many data have to be gathered covering the inputs and outputs of agricultural practice, transportation and the subsequent processing steps that are needed to produce tyres and medical products.

To simulate the environmental effects and yields of novel crops the EPIC model (Environmental Policy Integrated Climate - http://www.brc.tamus.edu/epic) will be applied. This model can simulate the

environmental field impacts of a crop. To collect data to feed the EPIC model an inventory has been made covering current agricultural practice for Guayule. These data include information on soil type, location, climate, water use, nutrient, pesticide and herbicide movements and crop yields. The evaluation of the subsequent processing steps that are needed for the production of, respectively, tyres and medical products will be handled in close cooperation with the Biopolymer Flagship.

Within the Plant Oils Flagship, the first case study is focused on the production of a range of wax esters for engine oils by the agricultural crop, *Crambe abyssinica*. It has yet to be established what issues have to be addressed in order to make a new plant-oil based lubricant able to replace the current use of mineral and synthetic oil derivatives.

As for the Guayule rubber case study, the environmental support theme first developed a process flow diagram for Crambe, ranging from the crop production to the end-of-life of wax ester oil to serve as a template for a LCA. The environmental effects will be measured using the EPIC model. Data for Crambe cultivation in several areas in Europe were obtained from the DICRA project (FAIR6-CT98-4333).

The cropping results from recommended fertilizer inputs for several locations in Europe (Germany, France, Italy, The Netherlands and UK) were selected.

For the agricultural part, Crambe should be compared with fallow land and with the cultivation of some other potential crop platforms for the production of wax esters (rapeseed). The bottlenecks observed in the agriculture of conventional Crambe species, are the variable yields, seed shattering behaviour, high transport volume of the seeds and the low availability of facilities for oil extraction (oil-mills). These issues will also affect the production of a genetically modified Crambe crop. At present data related to a future GM Crambe producing wax-esters 'in planta' are being collected. This includes factors such as dispersal, feral populations, animal predation, germination of GM-seeds, regulations for field trials, disposal and toxicity of wax esters compared to erucic acid containing oil and GM rape seed or *Brassica carinata*. The whole process is being carried out in close cooperation with the Plant-Oil Flagship. In order to compare the "in planta" production of wax-esters with the enzymatic "ex planta" and synthetic production lines further information on the different processing technologies used are being collected.

Science-society communication

Within the Science-Society support theme the main aims are to:

- develop and implement a media and science communication strategy based upon and extending current good practice procedures
- increase the public's awareness of the potential of biorenewables and the use of non-food crops
- aid communication of the results of the EPOBIO project to agriculture, industry and policy-makers through the media and other networks.

Work so far has focused on the following activities:

A review of current good practice in science communication via the media in the EU

This review aimed to analyse the current mechanisms of science-media communication, including how science news is consumed by the European public, how science stories are sourced by the media, science news distributors and science coverage and impact on a European scale. This information was drawn from current good practice recommendations, practical approaches taken by other EU funded projects and discussion with science-based press officers and representatives from media services (AlphaGalileo and the Science Media Centre). The objectives of the media analysis were to:

- analyse the coverage of renewable resources and products in the UK media
- explore how the media portrays renewable resources and how the information and issues related with this area are communicated.

This information in turn has defined the good practice recommendations which will be incorporated into the EPOBIO communication strategy. The key findings of the review were:

- Television and newspapers are the most common sources of science information for the European public;
- Science news relating medical or health issues receive the greatest media and public interest;
- Good communication networks and the provision of quality resources increases the effectiveness of uptake of news items by the media;
- The issues affecting the communication and dissemination of European research include the poor representation of European research in the European and worldwide media, the lack of awareness of some areas of European research by the European public and the difficulties of dissemination on a European scale.

Media analysis exercise to assess how non-food crops and biorenewables are portrayed in the UK media

The exercise was performed in two stages. First, a preliminary assessment of the approach was undertaken, assessing the ease with which online versions of UK newspapers could be accessed and searched using keywords, defined time periods and effectiveness of the approach in identifying relevant results. Secondly, a detailed search of 6 national UK newspapers was performed using either the Google News resource or newspapers' online search facilities. The search approach aimed to identify articles published during one month of 2006 and containing one or more of the following keywords relating to biorenewable issues:

bio-based, biomass, bioenergy, biofuels, bioproducts, biorefineries, industrial crops, non-food crops, renewable, vegetable oils and renewable

The report presented the analysis of the data retrieved from the media analysis. The conclusions of the report can be briefly summarised as follows:

- The keywords used to identify relevant news items varied in their effectiveness. This may be due to the specialised nature of these terms which makes it unlikely that they would be widely used in the mainstream media.
- The keywords 'renewable' and 'biofuel' were most widely featured in the news items found, relating to the debate about nuclear energy and discussions about future fuels, both of which formed major ongoing news subjects in June 2006.
- A significant proportion of news items (51%) were published in business and finance sections which suggests that uses of non-food crops and biological resources are viewed positively by investors and industry as areas of potential.

The media analysis demonstrated that although the media does cover issues relating to renewable resources (largely limited to renewable energy and biofuel), these issues are not well represented in the mainstream features and articles. This could be due to several factors, including a lack of interest or awareness of journalists, lack of provision of accurate and interesting information and resources and perception of the topics as low relevance or low interest. To address the points mentioned above, a mechanism is required to establish an information resource and media communication route to assist in raising the profile of non-food crops and renewable resources in the media as areas for discussion and potential in meeting society's requirements in the future.

Looking ahead

In addition, the first flagship reports written by the respective researchers will present a detailed scientific analysis of the products or processes selected as a priority for each flagship. The communications support theme will assist in the development of each of the flagship reports by providing a science-society aspect to the concepts presented. Therefore, each flagship report will contain a communications section which will identify the immediate areas for dialogue with the public and recommend a communication strategy to address these. This strategy will include presenting key messages, risks and issues. One approach taken to promote discussion of the issues involved will be the development of fact sheets to provide information on the flagship projects, the EPOBIO project and EPOBIO partners. The EPOBIO communication strategies developed for each of the flagships will be underpinned by the review of good practice and outcomes of the media analysis. The initial focus of the communication strategy will be the issues and opportunities identified by the first series of flagship reports.

Dissemination through BioMatNet

At the start of the EPOBIO project the BioMatNet website (http://www.biomatnet.org) was well established, having been supported through various EC programmes on and off since the early 1990s, with the last tranch of funding ending in December 2004. The site was and continues to be widely used by over 15,000 individuals a week as shown by the use statistics that are collected on a weekly basis (Figure 5). Hence, in the first instance new information (ITEMs) was added to the existing structure as the new EPOBIO site was developed in a new format resulting in differences in the location of buttons used to access the various features. These aspects have now been harmonized so that access to various features such as news items, events, contacts, etc. is the same for both sites. The translation facility has also been extended to the BioMatNet site.

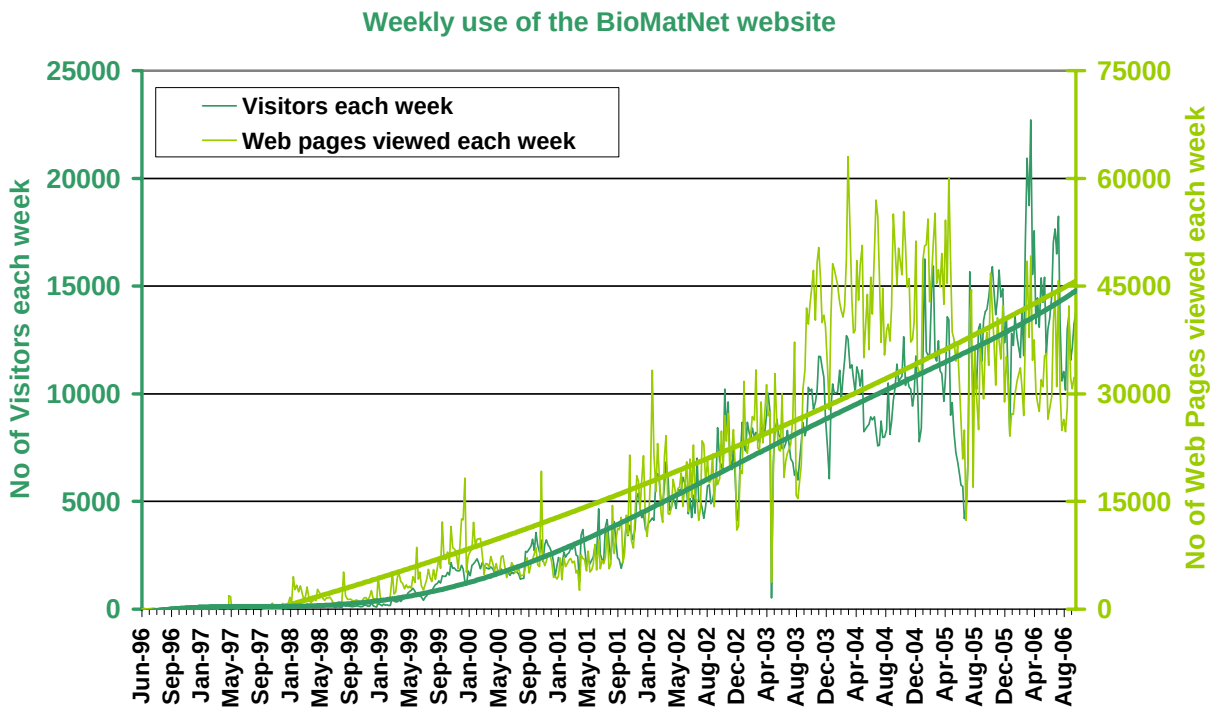

Figure 5: weekly use of the BioMatNet website.

The Database of Websites has been revised and is being expanded on a continuing basis, while new ITEMs are also added on an ongoing basis. These are listed periodically in ITEM News. In parallel with the new information, older ITEMs are being reviewed, removed or updated as appropriate and a new 'coding' system is being devised that reflects both emphasis of the EPOBIO focus and provides access to the developments in FP7 and the Energy Programme. The impact of these changes will become apparent as time goes by. However, they will not affect your bookmarks or the ability to access information on EC RTD activities through searches, either within the site or using a search engine.

The main change has been to gradually remove the old, often out-of-date, descriptions of commercial organisations, companies, trade associations, etc and to replace these (where possible) with an entry within the Database of Websites. This will ensure that in future information will remain as accurate and current as possible. Again, we invite organisations who would like to be included within this database to contact us: http://www.epobio.net/contact.htm