IENICA

Interactive European Network for Industrial Crops and their Applications

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Early in 2000 IENICA will launch a major, strategic report on the current status of industrial crops in Europe in terms of production, markets, barriers and opportunities, and recommendations for the future. The document will be available from the IENICA coordinator and from the European Commission. National reports, which form the basis of the IENICA report, will be available from the European Commission later in 2000. Executive summaries of all reports will be available on the IENICA internet site early next year.

IENICA Seminars

IENICA has organised three seminars this summer, two of which are reported below (see issue number 9 for a report on Natural Fibres Performance Forum). Publication of the proceedings from these meetings is currently under negotiation and they should be available soon. Details will be posted on the IENICA website.

Vegetable Oils - Meeting the Needs of Small, Medium and Large Industry was held in Wageningen, Netherlands on 21st - 22nd October 1999. The future of vegetable oil production and use was discussed and we briefly summarise the main issues.

There is a large surplus of arable land in Europe. Vegetable oil crops may be cultivated on this surplus but they will only be attractive if industrial crops receive stronger political support. Current EU policies are not favourable for vegetable oil production and use, and thus developing a farming, processing and marketing strategy based on long-term market demand and competitiveness without subsidies is difficult. Even large agricultural cooperatives, such as the Dutch CEBECO-Group, find it hard to develop economically viable non-food supply chains, despite increasing awareness of their sustainability and benefits for the environment.

Plant breeders have produced cultivars of oilseed crops that produce oils with new and novel fatty acid compositions, thus creating functionality for new markets. These efforts have hardly contributed to the development of new supply chains. This is partly because the agronomic performance of these speciality oil crops does not compare with that of commercial varieties grown for bulk markets and because the processing of speciality oils, their contract management, and the extra sales effort, investment, quality control, etc. required are all costly. Lower yields for farmers and higher costs for the crushing industry are not fully compensated for by higher prices for the end product.

Yet there are interesting large-scale applications of vegetable oils, including lubricants, detergents, solvents, polymers, surfactants, emulsifiers, biofuels and in the formulation of offshore chemicals and phytosanitary products. Niche markets exist for use as crop protectants, in pharmaceuticals and cosmetics. Use of new multifunctional catalysts allows the selective transformation of vegetable oils into specialities, such as dissymetric amines and fatty methyl esters. New, as yet unknown markets will develop additional demand for oils and it is likely that part of this demand will be for oil of vegetable origin.

However, in the short term, cost savings for the industrial end user of vegetable oils are more important than the environmental issue. Eco-labelling could stimulate demand but country-specific schemes are likely to be counter-productive.

There are also considerable political barriers to the exploitation of the new potential. The EC policies have caused distortion in the vegetable oil industry by causing fluctuations in availability, reduced subsidies and volatile prices of vegetable oils, at the same time blocking opportunities for new non-food crops. Consequently, some markets have become very inelastic by strict control of production through contracts between grower and user and no room is left for new initiatives or new crops. Agenda 2000 also further reduces the profitability of the oilseed sector and market restructuring will follow.

The development of new vegetable oils offers many benefits: new functionality, improved quality, biodegradability, carbon dioxide sequestration, and increased biodiversity. To realise this potential, Governments need to take the following actions: provide support for R&D in industry by Government funding, stimulate the use of vegetable oils by legislation, quantify the cost savings available through life cycle assessment, and stabilise the vegetable oil market by proper EU and WTO regulations.

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Speciality Chemicals for the 21st Century was held on 16th - 17th September 1999, in Valbonne Sophia-Antipolis, France. The seminar was jointly organised by IENICA and ADEME. Nearly 100 delegates from 12 European countries were present, including scientists, industrialists, producers and public organisations. The main objective was to evaluate the current status of knowledge, research, and technological and industrial developments for speciality crops and their products used by the cosmetic, chemical and pharmaceutical industries.

European resources, international markets, industrial opportunities and new technologies were discussed followed by presentations on:

1. Intermediary products - antioxidants, antibacterials, dyes, emulsifiers and chemically active molecules (terpenes) ;
2. Technical and technological advances in the fields of cosmetics and perfumes - development of new natural oils and their uses, oleochemistry, specific production of fragrant plants and plant-produced molecules;
3. Medicinal applications - classical allopathy, aromatherapy, phytotherapy, nutraceuticals and future technologies such as plant-produced vaccines.

Markets for these products are quite well defined and the products are available potentially. Links between growers, industry and consumers need to be established or consolidated, production variability must also be controlled. Four key words were mentioned for the development of speciality crops: added value, durability, secure production and legislation.

Added value is an opportunity for these crops, thanks to valorisation of by-products and to huge growth potential. A new dialogue should be established between agriculture and industry to promote long term development.

For the future, the most important challenge to take up is *durability* associated with reduced quality variability. As markets are unpredictable and varying, they should be controlled to permit *secure production* and sustainable development.

Renewability associated with favourable *legislation* should influence industrial orientation. Critical market evaluation and product development conforming to consumers' wishes are the key to establishing a prosperous and sustainable road. Finally, technological development is an ongoing requirement and challenge, particularly for extraction and for guarantee of crop quality.

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Forthcoming Industrial Crops Events

9 Dec 1999
European Partner Meeting on Use of Bio Materials for Non Food Applications
Sheraton Hotel, Schipol Airport, Amsterdam, Netherlands
Contact: Ms Jacqueline Ton
Tel: + 31 70 361 0250

27 - 29 March 2000
Starch 2000
Cambridge, UK.
Contact: Mrs M.A. Staff
Tel: + 44 (0) 1223 337007
Fax: + 44 (0) 1223 337000
E-mail: mas32@phy.cam.ac.uk

3 - 5 April 2000
Green-Tech 2000 International Conference & Exhibition on Sustainable and Renewable Raw Materials
Utrecht, Netherlands
Contact: Europoint BV
Fax: + 31 (0) 30 691 73 94
Email: info@europoint-bv.com
Internet: http://www.europoint-bv.com

For further details see the IENICA website.

Important Announcement

The EC **Fifth Framework Programme** call for proposals to be published in December 1999 is expected to contain important news for anyone considering obtaining funding under Area 5.2, Integrated Production and Exploitation of Biological Materials for Non-Food Uses, or Area 5.1.1, Sustainable Agriculture. Area 5.2 will be open for RTD proposals in March 2000 and not October 2000 as previously published in the indicative roadmap of the first workprogramme. The Diversification aspects originally found in Area 5.1.1, Sustainable Agriculture, is to be incorporated into Area 5.2, thus projects in this area can also be submitted in March 2000. For more details of funding through Framework Programme V see the NF-2000 website at http://www.nf-2000.org.

The Rediscovery of Dye Plants as Promising "Non Food Crops"

Dye plants as a source of natural colours, were in the past widely cultivated in the Mediterranean area and in Central and South America and represented crops of great economic importance. There were, in fact, important commercial trades of natural colours which found their main applications in textile, cosmetic and artistic sectors. Some of the most important dye plants were *Indigofera tinctoria* (indigo) and *Isatis tinctoria* (woad) for the blue colour, *Rubia tinctorum* (madder) for the red and *Reseda luteola* (weld) for the yellow. With the development of chemistry, the widespread availability of synthetic dyes determined the progressive disuse of the natural colours and consequently dye plant cultivation was also abandoned.

In more recent times, a major awareness for the welfare of man and the environment has initiated a "green wave" orientating consumers towards the use of natural products. This trend and some questions concerning the safety of the presently used synthetic colours, have drawn attention to natural colours and to dye plants.

Natural colours are mainly used in the food industry to colour a wide variety of products including meats, ice creams, butters, margarines, cheeses, yoghurts, beverages, syrups, jams and baked goods, their exploitation in this sector has good potential to increase due to the new EU proposals which allow a more extensive use of natural colours as food additives.

Natural colours are also employed in other industrial products such as cosmetics, pharmaceuticals, papers, textiles and paints. Their use has increasing opportunities in numerous potential applications, some of them rapidly expanding such as the bio-building industry, and other more restricted but very prestigious areas such as the restoring of works of art.

Natural colours possess important advantages:

- they are renewable resources,
- they have potential to be available in great quantities (the yearly potential production of carotenoid is estimated at about 100 million tonnes),
- they have low environmental impact,
- they possess biological properties,
- they show a good range of colours.

However, natural dyes are not competitive with synthetic dyes in terms of cost, supply and standardised quality.

To favour the introduction of natural colours on the market as more competitive materials having certain and constant characteristics of "quality", an integrated chain must be established including:

- the evaluation of future market development and demand,
- the cultivation of dye plants with growing strategies to ensure availability of raw material in the quantities needed
- the application of correct conservation techniques to avoid losses or degradation of the natural dyes,
- the development of suitable extraction techniques and analytical methods to assess the qualitative/quantitative composition of the raw material.

Considering these requirements and the pressing need to propose new profitable crop alternatives to the traditional ones, the Department of Agronomy of the University of Bologna activated research on dye plants as part of a project on "non food crops" (PRisCA) supported by the Ministry of Agriculture. This national research considered numerous species and varieties of dye plants, and aimed to develop and/or investigate the following aspects:

- adaptability of different species and genotypes to different environmental conditions,
- growing techniques which are modern and safe for the environment,
- influence of different variables (species, varieties, environments and fertilisers) on the accumulation and composition of useful components,
- effects of these crop residues on soil,
- knowledge of the chemical nature and properties of dye substances,
- techniques of extraction and analysis to characterise natural dyes,
- a rapid method to assess the dye content for screening experiments.

In the framework of this project, a series of germplasm collections of numerous species typical of the Mediterranean area and of other origins were grown in different areas of Italy, ranging from the North (Bologna), the Centre (Pisa) and the South (Palermo). These experimental field trials showed that many dye plants possessed a good adaptability to environment and good agronomic yields, some species were chosen and tested for further agronomic experiments and for characterisation and quantification of colouring compounds.

Here we report, as examples, the results of this research on marigold (*Tagetes spp.*) and red cabbage (*Brassica oleracea* L. var. *capitata*, f. *rubra*).

Tagetes spp.
Marigold is a source of carotenoids which are accumulated mainly in the petals and consist over 90% of lutein and lutein fatty acid esters. Dried marigold petals and marigold concentrates are used as feed additives to improve the pigmentation of poultry skin and lutein is a food colorant allowed by EC and reported as E161b. Ten cultivars of *Tagetes erecta* and *T. patula* having flowers of different colours, were evaluated for their lutein contents by high performance liquid chromatography (HPLC) and chroma meter measurement. On average, the analytical results showed that *T.patula* was richer in carotenoids than *T. erecta* (132 and 68 mg/100g respectively), but the content of carotenoids seemed mainly related to visually perceivable petal colour. The orange and deep orange petals were found richer in carotenoids than yellow or green yellow ones. This relation was confirmed by the chroma meter determinations which define the colour by measuring the L*, a* and b* values (Table 1). A good correlation between the dye content and both L* value (R^2= 0.98) and a* value (R^2= 0.96) was found suggesting that the chroma meter measurement could be a rapid and useful method to provide information on colourant contents in preliminary screenings.

Cultivar N°	Lutein + Lutein esters	Chroma meter values L*	a*	b*	Observed colour
1	18.00	67.60	0.14	39.69	Green-yellow
2	42.85	64.80	2.71	44.39	Pale yellow
3	94.37	65.10	3.99	49.07	Yellow
4	98.91	63.36	2.80	43.37	Golden yellow
5	285.29	59.91	12.32	48.33	Orange
6	569.90	55.50	15.72	43.60	Deep orange
L* lightness, a* green-red axis, b* blue- yellow axis.					

Table 1- Carotenoid contents (mg/100g of dry matter), chroma meter values and observed colours of six Tagetes cultivars

Brassica oleracea L. var. *capitata*, f. *rubra*
Red cabbage, generally cultivated as a vegetable, is rich in red colouring compounds belonging to the class of anthocyanins which are used as food colours allowed by EU and reported as E163. The majority of anthocyanins are obtained from grapes but there is a need to find alternative sources of these colourants and red cabbage could represent an interesting possibility. In Japan it is the major source of these dyes. Moreover, it is characterized by the presence of acylated anthocyanins having more stable colours.

The aim of our biennial study was to evaluate the dye contents of two varieties of red cabbage cultivated in Bologna and Ancona in North and Central Italy respectively, each subjected to nine mineral fertilizer regimes using combinations of phosphorous and potassium, the elements considered to influence the anthocyanin contents. The dye content was determined by a rapid analytical spectrometric assay which enabled numerous samples to be rapidly screened.

The results (Table 2) showed that dye contents were significantly affected by variety and localities whereas mineral fertilization seemed not to have significant effects. Both varieties produced good anthocyanin yields (from 44.6 to 55.9 Kg ha-1) and, considering the relatively low costs of cultivation, they could be proposed as promising dye plants.

Cultivar	Bologna 1st year	Ancona	Bologna 2nd year	Ancona	Mean
Roxy	1.06	1.00	1.06	1.54	1.17
Gradur	1.21	1.40	1.24	1.91	1.44
Differences between varieties, localities and interaction between varieties and localities significant at P= 0.01.					

Table 2- Anthocyanin content in cabbage heads (% of dry matter); means of fertilization treatments

Work is ongoing to evaluate the content of active substance in each species and/or genotype and to determine the optimal time of harvest to maximize the dye content.

In this study on dye plants we also discovered plants which are very rich in secondary metabolites of potential interest which may be exploited. These aspects could contribute to the introduction of cultivated dye plants.

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This is the final newsletter in the current IENICA series. The project is undergoing a change in direction and we anticipate a lull in activities until later in 2000. Please look at the IENICA website:
http://www.csl.gov.uk/ienica for further details.

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