IENICA

SUMMARY REPORT FOR EUROPEAN UNION

CROPS FOR SPECIALITY CHEMICALS

6.0 SPECIALITY CROPS

6.1 Introduction

Speciality products are generally higher priced or higher value products and as a general rule are traded in lower volumes than mainstream lipids, fibres, carbohydrates or proteins.

The number of species grown in EU-15 as speciality crops is very diverse; a summary of member states information is at Table 6.1.

Speciality products include:-

- Essential oils
- Essential fatty acids (γ linolenic acid)
- Pharmaceuticals (human and veterinary)
- Herbal health products
- Inks, colourants and dyes
- Perfumes
- Personal care/beauty products
- Novel plant protection products
- A range of intermediate products from which the above are manufactured.

6.2 Scientific and Technical Aspects

Information on the speciality crops and crop products sector is difficult to characterise, because of its extreme diversity and variability and is limited by the reluctance of certain parts of the industry to document for commercial reasons.

- Many species, varieties and strains of plant are involved. Chemotaxonomic definition is critical to successful exploitation, particularly of some essential oils, but currently there is little systematic definition.

- The methods of extraction, purification and transformation used with speciality plant feedstocks vary considerably, according to intended end product. Novel extraction technologies offer new options for products (eg super-critical extraction). Currently these are largely unexplored opportunities.

- The demands of the end user are frequently ill-defined and often depend upon organo-leptic tests or olfactory skills which are difficult to quantify systematically. This is particularly so with perfumes and essential oils.

- Markets are international and highly competitive. Frequently, natural products are adulterated with dilutents to increase their volume. Traditional and long standing arrangements are difficult to change in some product areas.

Table 6.1: Plants Producing Speciality Products in EU-15 by Species and Country

SPECIALITY CROPS	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	Sweden	UK
Allium spp				✓ C		✓ C			✓ C	C			✓	
Amaranthus		✓ P		✓					✓	✓			✓ P	✓
Angelica		✓ C		✓ P		✓ C			✓	✓ C			✓	✓
Artemisia	✓			✓	✓ P				✓				✓ P	✓
Apium graveolens						✓ C			✓ C	✓ C				
Anethium				✓ P		✓ C			✓	✓ C				
Artichoke		✓					✓ C		✓ C					
Basil		✓		✓ C	✓ C	✓ C	✓ C		✓ C					
Bearberry														✓
Birch				✓ C										✓
Bitter vetch														✓
Black currant		✓ P		✓ C	✓ C	✓ C							✓ C	✓
Bluebell														✓
Bog myrtle														✓
Borage		✓		✓	✓ C					✓ C				✓ C
Burdock					✓ C				✓					
Caraway	✓ C	✓ P		✓ C		✓ C			✓	✓ C			✓ C	✓
Cardamine impatiens										✓				
Chamomila spp	✓ C	✓		✓ C	✓ C	✓ C	✓ C		✓ C	?			✓ C	✓
Chenopodium quinoa				✓ P					✓	✓			✓	✓ P

SPECIALITY CROPS	**Austria**	**Belgium**	**Denmark**	**Finland**	**France**	**Germany**	**Greece**	**Ireland**	**Italy**	**Netherlands**	**Portugal**	**Spain**	**Sweden**	**UK**
Cerefolium										✓ C				
Chrysanthemum partheniam				✓		✓			✓	✓ C				
Clary sage				✓ P	✓ C									
Cynara cardunculus												✓ C		
Digitalis spp		✓ C		✓		✓ C			✓					
Drancucula										✓ C				
Dill				✓ C	✓ C	✓ C	✓ C		✓	✓			✓ C	
Echium														✓ P
Echinacea	✓	✓ P	✓ C	✓ C		✓ C			✓	✓			✓	✓
Erica & assoc spp						✓ C	✓ C							✓
Euphorbia spp					✓	✓	✓ C		✓	✓				✓
Eyebright														✓
Fennel	✓ C	✓		✓ C	✓ C	✓ C								
Fenugreek					✓ C				✓ C					
Gentiana	✓ C				✓ C	✓ C			✓					
Hevia brasiliensis														
Hypericum spp	✓ C	✓ P	✓	✓ P		✓ C			✓	✓			✓ P	✓
Hyssop		✓		✓ C	✓ C				✓					
Juniperus spp				✓ P										✓ C
Lavander/lavandulin					✓ C		?		✓ C			✓ C		✓ C
Lactuca virusae							✓ C			✓ C				
Levistica				✓		✓ C				✓ C			✓	

SPECIALITY CROPS	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	Sweden	UK
Llalemantia						✓				✓				
Lobelia inflata										✓ C				
Lovage				✓	✓ C	✓ C							✓	
Lunaria spp						✓			✓	✓ C				✓ P
Madder			✓	✓		✓			✓			✓		✓
Marjoram	✓			✓ C		✓ C	✓ C		✓					✓
Melilota					✓ C	✓ C			✓	✓ C				
Meadowsweet					✓ C									✓
Melissa	✓ C	✓		✓ C	✓ C	✓ C			✓				✓ C	✓
Milk Thistle	✓ C													
Nepeta spp		✓		?										✓ P
Oenothera spp		✓ P		✓	✓ C	✓ P			✓	✓ C				✓ C
Osteospernum spp										✓ C				
Papaver spp		✓		✓ C	✓ C				✓					✓ C
Passiflora					✓ C				✓					
Parsley (seed)				✓ C	✓ C	✓ C	✓							✓ C
Peppermint	✓ C	✓		✓ P		✓ C	✓					✓ C	✓	
Petroselina						✓ C	✓			✓ C				✓
Pimpinella saxifraga						✓ C				✓ C				
Psyllium spp					✓ C									
Plantago spp	✓ C	✓		✓		✓ C				✓ C				✓
Pyrethrum spp		✓		✓					✓					✓
Rosa and related spp						✓ C							✓ C	✓

SPECIALITY CROPS	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	Sweden	UK
Rhea sinensis										✓ C				
Rosemary					✓ C									✓
Rowan														✓
Sage	✓			✓ C	✓ C	✓ C	✓ C		✓ C			?	✓	✓
Saffron					✓ C		✓ C		✓ C			?		
Sambucus spp	✓ C			✓		✓ C							✓ P	
Sea buckthorn			✓	✓ C		✓ C							✓ P	✓
Spearmint				✓ P	✓ C	✓ C	✓ C		✓			✓ C	✓	✓ C
Stokesia spp										✓				✓
Taraxacum				✓		✓ C			✓	✓ C				
Tagetes spp	✓	✓ P		✓					✓					
Tarragon				✓ C	✓ C				✓					
Taxus				✓		✓								✓ C
Thymus spp	✓ C			✓	✓ C	✓ C	✓ C		✓	✓ C			✓ C	✓
Valerian	✓	✓ P		✓ P	✓ C	✓ C			✓	✓ C			✓	✓
Verbena spp		✓			✓ C				✓					
Vernonia spp									✓	✓				✓
Woad				✓ P	✓ C	✓ C	✓ C		✓ C	✓		✓		✓ P
Yarrow	✓ C			✓		✓ C								✓
Yellow Iris														
Viola tricolour				✓	✓ C	✓ C				✓ C				
Weld												✓		

- Waste products with little or no value can offer cheap alternatives to speciality grown crops. In terms of essential fatty acids (eg γ linolenic acid), these opportunities deserve further investigation but would impact adversely on primary specialist crop production.

- The protection of intellectual property rights (IPR) and registration procedures for naturally developed but extracted plant products is confusing and can be prohibitively expensive. Additionally, there is inconsistency in regulation; whole plants may be unregulated but simple extracts fully regulated.

- Consumer demand and market trends are frequently unpredictable, follow fashion and can be short-lived. As a consequence, the determination, execution and exploitation of RTD programmes is difficult.

- In many plant species, quality and proportions of desired plant-derived molecules vary according to location, method of growing, time of day, stage of physiological maturity and harvest method.

Detailed scientific and technological issues for such a range of plants and products are difficult to quantify. Production is currently based on an individual crop plant, product or group of similar products basis and is therefore small scale and potentially expensive. The primary exception is the pharmaceutical sector where massive screening procedures check tens of thousands of plant products and their metabolites each year. Whilst not driven by the EU, the United National Organisation Initiative [plant products especially Amazon] may provide an outline approach for a structured and rational analysis and appraisal of traditional medicines and the potential to extract and purify active elements for use as pharmaceuticals.

6.3 Markets

An overall market appraisal is not available for the full range of speciality plants and plant products. France is the largest European producer of speciality crops, judged on an area basis, with Spain second largest. French estimates suggest in 1995 the annual world demand was of 45,000 tonnes of essential oils and 50,000 tonnes of aromatic plants. It is crucial to note though that market demand and prices are highly variable and react quickly to market supply, magnitude of potential harvests and their quality. Despite this it is considered that the 1995 data are low estimates for 2000.

Europe plays a major role in the international trade of medicinal and aromatic plants with an average of 120,000 tonnes imported annually from more than 120 countries. Germany, Bulgaria and Poland are among the world's top exporters. Between 1,200 and 1,300 species native to Europe are commercially traded and though some species are cultivated (probably only 10-15% of total volume), collection from the wild still plays a major role. The source of these wild plants is mainly Albania, Turkey, Bulgaria, Greece and Spain. The overall volume of wild plant material collected in Europe is estimated as 20,000 - 30,000 tonnes annually. According to the results cited in the TRAFFIC report in 'Europe's Medicinal and Aromatic Plants: Their Use, Trade and Conservation', at least 150 medicinal and aromatic plants are threatened as a result of over-collection, destructive harvesting techniques and habitat loss and change. This situation is unsustainable and probably politically unacceptable.

6.3.1 Essential Oils

Informal estimates of world markets for 2000 and oil yield were noted by the IENICA co-ordinator, Melvyn F Askew, for a range of essential oils:

Table 6.2 : Oil Yields – World Market Tonnage

Plant	***World Market Tonnage***	***Available Oil Yield kg/ha***
Tansy	1	25
Artemesia (wormwood)	7	25
Helichrysum	1.5	7.5
Thyme	45	30
Penny Royal (*Mentha pulegium*)	20	?
Melissa	< 1	
Caraway	35	85
Carrot seed oil (from surplus seed)	10	-
Vetiveria	250	50
Calamus	6	75
Geranium	6	33
Rosemary	80	50
Hyssop officinalis	2	8
Tarragon	10	12
Achillea (Yarrow)	1.5	5
Lavandulin	650	87
Fennel	260	87
Coriander	200	62
Chamomila recutita	6	7.5
Tagetes minuta	12	25
Sage	40	37

The above data are derived from data given during a conference presentation by Brian Lawrence of Reynolds Tobacco 60, USA.

6.3.2 Medicinal Plants

Market divided into:

(a) Medicinal- with proven disease related claims for activity, subject to licensed medicine controls. These products are controlled by large companies because they require large budgets to develop, test and market new products. Generally characterised by integrated production chains.

(b) Food supplement – improvement of well being. The market comprises a large number of products including herbal teas, natural remedy etc. Limited regulatory control.

The global market for herbal supplements currently exceeds $15 billion, with markets worth about $7 billion in Europe, $2.4 billion in Japan, $2.7 billion in the rest of Asia and about $3 billion in North America. The US market is growing at the rate of about 15% per year. Estimates suggest similar growth rates in other areas. Pharmaceutical companies are positioning themselves to compete for the approved herbal pharmaceutical market of the future. They will probably define three levels of control; control of the raw materials (the plants); control over the manufacturing process; and control of the final product. Process patents will be also important in establishing a proprietary position. Advances in analytical techniques, such as Gas Chromatography (GC), Gas Chromatography-Mass Spectroscopy (GC/MS) and other separation techniques will help to characterise and standardise the complicated botanical mixture and support patent claims.

Biological assays are important for measuring the biological activities of individual compounds and whole extracts. In addition, checks are required on quality in terms of external contaminants.

6.3.3 Perfumes and cosmetics

A great number of plants, mass or speciality crops, picked or gathered, are used in perfumes for their olfactory properties. In most instances the scent is obtained by a complex mixture of natural and synthetic products (90% of perfume feedstocks).

(a) Industrial scents (detergents): Cost price is the determining factor in this sector. The only sustainable substances are those that are cost-competitive with imported or synthetic products eg lavandin.

(b) Cosmetics and perfumes: This sector comprises essentially body care products but many include a mixture of materials, including perfume, in formulations. There are a number of plants with historical basis for skin treatment eg *Callendula* but little scientific data. The Body Shop has significantly increased interest in this type of product.

(c) Alcohol-based perfumes: This sector uses essential oils and other plant extracts, but must allow for competition from synthetic products, where creativity is far from exhausted, and international competitors. These factors have induced a steady drop in producer prices.

6.3.4 Speciality chemicals – Colourants, Dyes etc.

Estimates of world or EU-15 markets and their values for colourants and dyes are variable. Hancock reports:

(c) Total world dyes market value as £2.5 billion/annum in 1997.

(d) Consumption of dyes to colour textiles on a world scale is 700,000 tonnes/annum

(e) Dyes comprise < 1% of total world sales of organic chemicals.

(f) World demand for indigo (1976) 13,000 tonnes/annum, NB: this excludes new ink jet printer applications, which are currently being developed from woad *Isatoris tinctorius.*

(g) Value of world food colourant market (1989) was $320 million, of which approximately 50% was natural product. Food colourant market was growing at 10% /annum (1987) with predictions that by 2000, 50-75% of colourants would be naturally derived and valued at $450 to $675 million approximately from natural products.

(h) There are limitations on capability of agricultural crops to provide sufficient dyes for existing world textile production. Therefore, total replacement of synthetic dyes is impossible with current plants and current technologies.

6.3.5 Novel products

(a) Bulk production of pharmaceutically-active proteins such as antibodies and industrial enzymes from plants. There has been considerable research activity and the interest is now in their application to a wide range of problems related to agriculture.

(b) Agricultural pesticides and sprout suppressants
Carvone volatile component of Caraway oil has been shown to supress sprouting of potatoes. Recently the attractant pheromones produced by sexual female aphids has been identified and a plant souce identified for future development.

The above market summary highlights the exploitation of wild as well as cultivated plant species and indicates a potential for development of new markets from potential new crops, particularly if the collection of wild species is not sustainable in the longer term. However, it is to be noted that in the short-term in particular, a number of these species may not be adapted to conditions in EU-15.

6.4 Barriers to Progress

6.4.1 Crop production

The large number of plant species involved means that the potential for improved plant productivity and management is limited, except for those species being developed by major medicinal companies. Identification of most important species for support is desirable. Cultivation methods which reduce labour input are essential to enable EU producers to compete on the world market. Organic production systems are likely to be required to maximise product price, particularly in the human health product market. This poses problems of developing efficient and sustainable organic production systems.

The identification of threatened species, which are currently harvested from wild stands is important to ensure environmental sustainment and a continued supply of plant material. A domestication programme should be short or alternative species identified.

Many species require hand harvesting, resulting in high production costs. While some progress has been made further effort is required in this difficult area.

Efficient processing is important, most crops are processed using well tried technology. The development and application of new processes is important to maximise product extraction efficiency.

6.4.2 Industrial Use

Traditional uses are generally well developed, but there is scope for the substitution of synthetic and imported materials. New uses, particularly those with potentially high value products, need continued development. Particular attention should be given to medical and novel uses and the substitution of synthetic products.

Specification of quality requirements are generally poorly defined, improvement can help whole industry.

6.4.3 Economic

Crop production is generally high risk, with crop performance and quality and end product volatile. There is need for greater co-operation between producers, processors and end product manufacturers to ensure improved economic returns from more stable production, assured production systems and improved product quality.

6.4.4 Environmental

The transfer from wild harvesting, particularly of vulnerable species, to cultivation is a major environmental challenge. It is essential to maintain consumer confidence and product demand.

While the natural status of products derived from plants is reasonably well known in the herbal remedy/cosmetic area, they are less well communicated to the general public in other areas. Education coupled with EU wide schemes to label natural, environmentally friendly products would enhance consumer demand.

Many plant species require minimal or no (organic) inputs of chemicals and fertilisers and are therefore environmentally desirable. Identification of their production status should be encouraged and further labelling introduced.

6.4.5 Legislative

To enhance the development of plant products and to meet International Agreements on Climate Change and Biodiversity an EU legislative framework should be established. This would be particularly aimed at extending the legislation with regard to identifying sustainable and organic products.

The legislation regarding the licensing and monitoring, particularly of herbal products, appears to vary across the EU. There is need to formalise this situation to protect the consumer.
The protection of intellectual property rights (IPR) and registration procedures for naturally developed plant products is confusing and can be prohibitively expensive. Clarification and simplification is required to encourage further innovation.

6.4.6 EU Actions

The status of specialist crops within the CAP is confused and few benefit from the support given to mainstream agricultural crops. This policy should be reviewed.

Plant product specifications are poorly defined, to assist the EU trade specifications should be introduced to standardise product qualities.

6.4.7 Communication

Communications between the main participants in the specialist crop area, farmers, seed vendors, storage operators, research bodies, processors and industrial users need improvement. Only by multi-path communication will the confidence and requirements of all parties be defined and understood and implemented.

Communication of the new products and their environmental benefits to industrial and domestic users will help to overcome lack of knowledge and enhance product demand.