Last updated: 20th September 2002

CORIANDER (Sheep's Parsley)

Family: *Umbelliferae*

Genus: *Coriandrum*

Species: *sativum*

Source: http://www.magicalmusings.com/coriander.gif

Source: http://www.naturopath.virtualave.net/images/coriander.gif

Contents

General Background

Coriander is an annual herb originating from the Mediterranean area. A weak-stemmed glabrous plant, growing to about 60cm height, all parts of the plant have a strong foetid odour, from which the plant takes its name. Coriandrum is derived from the Greek for a bug and refers to a shield-bug. The leaves are of two types, lower with leaflets and upper divided into narrow linear segments. Some varieties form a rosette of leaves at the base. The plant forms a tap root. Flowers are pink or white and small in small loose umbels. Inner flowers are smaller and sterile, outer ones with longer petals are fertile. Fruits are globose and approximately 3mm in diameter. They are glossy green, and ripen to a light yellow-brown colour and are ribbed, each fruit contains 2 seeds.

Coriander is currently chiefly grown in India, Asia and central Europe. In Europe it is grown almost exclusively for the seeds which when dried have a mild aromatic flavour. The seeds are ground and used as a spice, particularly in eastern Europe. The essential oil is also distilled from the seeds and used in condiments and liqueurs. The leaves are extensively used in eastern cooking and in Indian food.
Coriander is most likely a native of the eastern Mediterranean and from there spread to India and China. The Romans are probably responsible for introduction of coriander to northern Europe. The plant is hardy and easy to grow and is increasingly being cultivated in Europe.

Details of Quality Characteristics

The seeds contain on average 18% oil, this can vary between 8.8%-19% according to strain. Essential oil content of seeds is approximately 0.84%. However as a result of

ECLAIR Programme AGRE-0039: Seed oils for new technical applications – (SONCA), high seed yield (2 t/ha) and seed oil content (about 23%) coriander has been bred. Breeding of coriander to increase levels of petroselinic acid is limited due to lack of commercial interest at present.

Composition of fatty acids in seeds of coriander:

Main Components	% of all Fatty Acids
Petroselinic acid C18:1	68.8
Linoleic acid C18:2	16.6
Oleic acid C18:1	7.5
Palmitic acid C16:0	3.8

(Minor components: Stearic acid, Vaccenic acid, Myristic acid)

Petroselinic acid (C18:1) can be split to produce C6 (adipic acid) and C12:0 (lauric acid) molecules. These could play a part in displacing imports of C12 oils from coconut / palm kernel oils and production of adipic acid from fossil sources.
Adipic acid is used for the manufacture of a wide range of polymers including high grade engineering plastics. Adipic acid has a global market in excess of £2.5 million tonnes worth over £1 billion.

Composition of essential oil in seeds of coriander:

Main Components	% Total Essential oil
Linalool	67.7
Alpha-pinene	10.5
Gamma-terpinene	9.0
Geranylacetate	4.0
Camphor	3.0
Geraniol	1.9

(Minor components: Beta-pinene, Camphene, Myrcene, Limonene, *p*-Cymol, dipentene)

Current Production and Yields

The estimated world market tonnage of coriander oil in 1999 was 200 tonnes from which the available oil yield was 62 kg/ha. The above data was given during a conference presentation by Brian Lawrence of Reynolds Tobacco, 60, USA.
The planted area of Coriander in mainland France in 1995 was between 10 and 100 ha, the products of which would have been used for medicinal, aromatic or the perfume industry. (Source IENICA summary Report for the European Union 2000).
Yields in Europe vary between 870 kg/ha to 2100 kg/ha of coriander seed. Central Europe averages 1000 kg/ha of seed yielding 0.5% volatile oil. Winter-sown crops have demonstrated a distinct yield advantage. Roots of young coriander plants have been shown to withstand temperatures down to ⁻9ºC, but it is generally thought to be only those varieties that form a rosette which are suitable for winter sowing.
Aqua Oleum (1993) state that Russia produces a high quality coriander oil, with a linalool content in excess of 55%. Bauer (1942) found that coriander attains its greatest yield of volatile oil (0.9%) with a growing period of 110-122 days in cool and damp weather.

The feasibility of growing coriander itself on a large scale is being studied after the SONCA project. The use of advanced plant breeding, in conjunction with biochemical studies, could result in high-oil, high petroselinic acid coriander varieties within five years.

To produce one twentieth of the global requirement for adipic acid from coriander or oilseed rape would require about 500,000 hectares of arable land, an area similar to that of the current oilseed rape crop in the UK.

Constraints upon Production

Derivatives or polymers from under-utilized fatty acids such as petroselinic acid (coriander) are regarded as new materials, according to European chemical regulations (Chemikaliengesetz – Chem G). This means that toxicological and ecological tests are obligatory at a very early stage in development of new products, in order to establish environmental impact and social acceptance. The cost of testing new substances is

prohibitively high (see Table below) when developing novel bulk chemicals such as surfactants.

Costs of testing new materials according to Chem G

Amount of Substance	Cost
>10kg	50,555 DM (0.025 M Euro)
>100kg	150,000 DM (0.075 M Euro)
>1t	450,000 DM (0.225M Euro)
>100t	1 million DM (0.5 M Euro)
>1000t	3-4 million DM (1.5 –2 M Euro)

Markets and Market Potential

The fatty oil of coriander is of interest because of the high level of petroselinic acid. Petrosilinc acid has potential non food applications in oleochemistry. This oleic acid-like isomer opens up another potential approach to the manufacture of medium-chain acids, since it can be split into lauric (C12:0) and adipic (C6) acids by oxidative cleavage. However oil percentages in the range of 30 to 40% are needed for an economically viable crop. Another approach would be to transfer the genes responsible for petroselinic acid formation from coriander to an established oilseed crop, such as rapeseed. Further research is required before coriander becomes a viable industrial crop (IENICA Report 2000).

Adipic acid is used for the manufacture of a wide range of polymers including high grade engineering plastics and has a global market in excess of £2.5 million tones worth over £1 billion. At present, adipic acid is derived from mineral oil by a process which releases gasses such as N_2O that damage the ozone layer and contribute to global warming.

Petroselinic acid is an isomer of oleic acid and is used as a plastics lubricant, in the manufacture of nylons and for cosmetics. Oleic acid (C18:0) is used in many industrial processes, and in the food industry. It is a major constituent of salad cream and mayonnaise. Petroselinic acid is an isomer of oleic acid and is used as a plastics lubricant, in the manufacture of nylons and for cosmetics

Other more recent uses include the use as a green vegetable by some ethnic groups and to flavour dishes and foods such as pickles, sauces, confectionery, and, increasingly in the oleo-chemical industry

Coriander seed oil is used in the flavour industry, although it is not a popular oil in aromatherapy. Other more recent uses include the use as a green vegetable by some ethnic groups, to flavour foods and in the oleo-chemical industry. Coriander is also used for cosmetics, toiletries, soaps, detergents, surfactants and emulsifiers. (Source – Crops for industry and energy in Europe. European Commission. 1997)

Other Information

Much of the agronomy of coriander is well proven, it likes a sunny, open position on light soils with plenty of water. It is usually spring-sown but is hardy when young and can be autumn-sown. Ideally 50 - 70 plants/m^2 should be established. Application of nitrogen up to 50kg/ha increases seed yield markedly, this may be added to the seedbed or as a top dressing. Above this level, no yield benefits are gained. Weed control in the young crop is essential, there are few herbicides recommended for use but many have been shown to be effective and safe. Seeds are harvested when 50% of fruits have ripened.

Coriander produces a lot of nectar and attracts many different insects for pollination. It is also a good melliferous plant, allowing bees to collect a lot of honey.

Coriander freely cross-pollinates and does so without showing signs of inbreeding depression. Breeding techniques similar to those used for oilseed rape can therefore successfully be used for coriander. Breeding has concentrated on introduction of resistance to bacterial blight, drought resistance and increase of fatty acid content and essential oil content in seeds. Coriander is also susceptible to drought in light soils, and weed control is essential in juvenile stages, particularly those varieties which form a rosette.

Yields of coriander dropped to half in some trials undertaken during the ECLAIR Programme AGRE-0039: Seed oils for new technical applications –SONCA, due to disease epidemics caused by the bacterium *Pseudomonas syringae.* Coriander can also be affected by bacterial blight (*Ramularia coriandri*)

Research

Scientific interest in Coriander as a novel crop has been expressed by Denmark, Germany, Italy, Netherlands and the UK.

Oilseeds as a renewable source of environmentally-friendly polymers

Adipic acid is used for the manufacture of a wide range of polymers. Scientists at the John Innes Centre in Norwich, UK are developing alternative, more environmentally friendly sources of adipic acid, derived from renewable oilseed crops. Two complementary approaches are being taken. First, an existing commercial crop, oilseed rape, is being modified by adding genes from a minor crop, coriander, to create new varieties containing petroselinic acid in the seed oil. Meanwhile, methods to convert petroselinic acid into adipic acid plus lauric acid (useful in detergent manufacture) are being developed by the chemical industry.
Secondly, the feasibility of growing coriander itself on a large scale in the UK is being studied. The use of advanced plant breeding, in conjunction with biochemical studies, could result in high-oil, high petroselinic acid coriander varieties within five years.

Commercial Success of ECLAIR Programme

AGRE-0039: Seed oils for new technical applications -SONCA
The Project Summary, Links to Individual Project Reports and Preface and Overview are available in separate items and can be found at http://www.nf-2000.org/secure/Fair/S1125.htm

AGRE-0039: Seed oils for new technical applications – SONCA
Two approaches were taken in this research coordinated by Institut für Pflanzenbau und Pflanzenzüchtung, Georg-August-Universität, Germany. The first took advantage

of current developments in plant genetics to select varieties of established oil crops (rapeseed and sunflower) that could produce oil of the quality required for industrial applications.

The second attempted to improve the agronomy of three plant species (coriander, Euphorbia lagascae and Cuphea) that have the capacity to produce oils containing high proportions of unusual components such as petroselinic and vernolic acids, as well as medium chain fatty acids.

Coriander genotypes were selected with promising high seed yields (about 2 t/ha) and seed oil contents (about 23%). The agricultural potentials of this species were confirmed in field scale productions (total of 30ha). Yields, however, dropped to half in some trials due to disease epidemics caused by the bacterium *Pseudomonas syringae.*

Extraction of the fatty oils from coriander fruits is technically feasible by screw pressing, however, there are still problems with obtaining sufficient quantity of these oils. Although these oils are potentially valuable, a market has not been established.

Useful Web sites

www.wholeherb.com/ID/HG188A.HTM - Provides general information on the plant, including appearance, propagation methods and harvest techniques

http://www.nf-2000.org/secure/Fair/S1125.htm

BioMat Net

Coriander (Coriandrum sativum)

AGRE-0039 - Seed Oils for New Technical Applications SONCA

Crops for Flavours/Fragrances, for detergents, for pharmaceuticals/cosmetics, for Paints/Coatings/Plastics, for Fine Chemicals.

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