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JOJOBA

Family: *Simmondsiaceae*

Genus: *Simmondsia*

Species: *chinensis*

Source: http://www.kulak.ac.be/irc/topic1.htm

Contents

General Background

Jojoba cultivation in Israel

Jojoba is a small perennial evergreen woody tree or shrub that ranges from 0.5-6m (but usually 2-2.5m) in height with a tap root that is able to penetrate 15-25m below the soil surface. The plants are well adapted to desert conditions, originating from the Sondran and Baja deserts (USA). The deep rooting system is able to extract water from deep in the soil profile so drought conditions can be tolerated. In the desert (<100mm rain/year) the plants persist as small stunted bushes and survive temperatures of 45ºC. Under more favourable conditions the plants thrive and potentially have a life span exceeding 100 years.

The plant normally flowers in spring after the autumn/winter rains. Ideal conditions for growth are annual rainfall of 500-600mm and flat areas that are less than 350m above sea level. The plant is dioecious (female and male flowers are found on separate bushes). Male flowers form small yellow balls, female flowers are green and inconspicuous and are wind pollinated. The seeds, after ripening and harvest in the summer, are crushed and give a liquid wax yield of about 50% by weight.

Details of Quality Characteristics

The oil or liquid wax extracted from jojoba (50% by weight wax in seed) is a unique unsaturated oil composed of non-glyceride esters consisting almost entirely of straight-chain acids and alcohols. These compounds are difficult to synthesise commercially and the only other source is the sperm whale.

The wax is a mixture of straight chain wax step, different from the triglyceride oils, characteristic of oilseed crops. The great majority of the straight chain wax esters are C40 or C42. The fatty acids and alcohols making up the esters are unsaturated and have long carbon chain lengths: C29 and C22 are the most common.

The waxes are indigestible, odourless and clear, the processes of isomerisation, hydrogenation and sulphur-chloride treatments produce a range of products from thick creams to crystalline waxes to oils and rubbers.

Sulphurisation produces a lubricant with enhanced film strength and lubrication. Jojoba compounds are mainly employed in the manufacture of cosmetics.

The residue which remains after oil extraction is a high protein meal (33%), it has limited potential in the feed industry as it contains an appetite suppressant (*simmondsin*).

Current Production and Yields

The product which is traded is called jojoba oil, potential world production of this product is currently around 3,500 metric tonnes per year, the major production areas being; USA, Mexico, Costa Rica, Australia, Brazil and Paraguay. Commercial plantations also exist in Argentina, Egypt, Israel and Peru. The total area covered by the crop throughout the world is currently around 8,500ha. In 1999-2001 Israel produced one third of the world production of jojoba, average yields are around 3.5 tonnes/ha (potential yield is 4.5 tonnes/ha), this is relatively high compared with production potential in Argentina and the USA. World demand is currently estimated at between 64,000 and 200,000 tonnes/year.

Because there appear to be few natural products that would directly compete with jojoba oil the future of the product appears to be bright.

Constraints upon Production

Jojoba's high value has led to its cultivation in many localities, largely with disappointing results due mainly to unsuitable climatic conditions. Optimum temperatures for vegetative growth are 27-33ºC with at least one month at 15-20ºC to break dormancy of flower buds – at constantly high temperatures jojoba never flowers. Frosts of below –3ºC damage the crop, and if frosts occur during flowering the flower buds are damaged and the crop may be lost. Although Jojoba is very tolerant of drought, 750mm of rain or irrigation are necessary for good yield. The plant is susceptible to water logging and low pH.

It is a crop for semi-arid zones of the world and cultivation of the crop commercially is therefore carried out in Mediterranean to tropical regions.

Markets and Market Potential

The cosmetic industry appears to be the principal market for jojoba oil products, around 2,000 tonnes per year are thought to be utilised by this industry, this equates to almost 80% of the total market share. The other major industry using jojoba oil is the pharmaceutical sector. Lubricant applications provide a market for around 100 tonnes of jojoba oil annually.

Jojoba oil is a high quality substitute for sperm oil (from the sperm whale), availability if this product is limited now due to the restrictions placed on whaling.

The meal left over from crushing has a high protein content but needs detoxification before it can be fed to livestock.

The shrub's peanut-sized seeds produce an oil which engineers at the United Arab Emirates University in Al-Ain and the Helwan University in Cairo combined with methanol to make a fuel call 'jojoba methyl ester', which was successfully tested as a fuel for vehicles.

Potential Uses for Jojoba

Type of Modification	Description of product	Proposed Uses
Filtered natural oil	**Clear liquid, odourless, stable, indigestible**	**1. Dietary cooking oil 2. Cosmetics 3. Anti-foam agent in antibiotic fermentation 4. Leather fat-liquoring 5. Blending with polyethylene as a plastic modifier**
Isomerisation	**Thick opaque cream**	**1. Cosmetic creams 2. Pharmaceutical creams**
Hydrogenation	**Hard sparkling white semi-crystalline wax**	**1. Candles, polishes 2. Treatment of papers, textiles, insulating**

		materials, matches, carbon paper **3. Manufacture of soap, salves, crayons etc** **4. Coatings for foodstuffs**
Treatment with sulphur chloride	**A range of forms from oils to rubbery solids (factices)**	**1. Manufacture of varnishes, rubber, adhesives, lineoleum** **2. Printers ink**
Sulphurisation	**Liquid**	**1. High pressure, high temperature lubricants for use in gearboxes, differentials etc** **2. Crankcase lubricant** **3. Cutting oils for use in machine shops** **4. Lubricant for videotapes**

Other Information

Jojoba prefers well drained soils. Heavy clay soils or those liable to flood are unsuitable and plants will die if waterlogged, even for very short periods.

Very sandy soils with low water holding capacity are suitable if water and fertiliser are applied liberally. The plant grows best in soils of pH 6.0 up to 8.5 and is salt tolerant. Drainage is critical as well as adequate water supply (400-700mm +/annum) to produce reasonable seed yields.

It is recommended that prior to planting the ground remains fallow for up to 12 months to help control weeds and conserve moisture. Plants are planted in late spring or summer (when soil temperatures reach 20ºC) and should be irrigated by a trickle system for the first three years until sufficient root growth is established. Sufficient Phosphorus, some Nitrogen and maybe Potassium should be available at planting, soil tests will help to determine accurate values.

Jojoba crops are reasonably expensive to establish but cheap to maintain. Plants will be planted in rows to ease harvesting, this takes place from February to late May,

from the third or fourth season after establishment, by means of vacuum harvesters picking the fallen fruit from the ground. Harvesting leaves the ground bare and at risk from wind damage, protection should therefore be provided. If not too wet the fruit can survive on the ground for a number of months before collection. Peak productivity is generally achieved by year twelve.

Weeds should be controlled as much as possible prior to planting. The only known pest to the plants is *Heliothis* caterpillars, they are unlikely to require any control. Disease problems are worse in poor draining soils, the only major known problem is *Verticillium*.

Research

Jojoba is currently not sufficiently domesticated for commercial production in Europe, research is continuing in Southern European countries, including France, Italy, Spain, Greece and Portugal to investigate the potential for successful production. Research is being carried out relating to plant exploration and evaluation along with crop improvement and breeding techniques.

In order to optimise production and yields of jojoba further research is required in the following areas; weed control, nutrition, varietal selection and harvesting equipment.

Jojoba meal has been incorporated into feed rations of broilers in Belgium, it is thought that 4% of jojoba meal in the feed restricts the feed intake level to give a favourable muscle to fat ratio, this eliminates over fat birds. This strategy is being tried in other animal species in an attempt to achieve the same effect.

Useful Websites

http://www.agric.wa.gov.au/environment/trees/tree_crops/jojoba_introduction.htm - Jojoba - An Introduction for Western Australia

http://www.hort.purdue.edu/newcrop/ - A number of research papers on Jojoba, including a fact sheet and New Crop Development in Europe

http://www.ijec.net/consumers/ - International Jojoba Export Council

http://www.nre.vic.gov.au - Farm Diversification Information Service: Jojoba

BioMat Net

Jojoba (Simmondsia chinensis)

Crops for Pharmaceuticals/Cosmetics

National Activities – Austria – Renewable Raw Materials, Pave the Way for Sustainability

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