Last updated: 20th September 2002

CUPHEA

Family: *Lythraceae*

Genus: *Cuphea*

Species: *species*

Source: http://www.mobot.org/hort/outreach/merit/Cuphea.jpg

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General Background

Cuphea is a genus of low-growing herbaceous or annual plants. There are over 45 species of *Cuphea*. The plant varies from 20 cm to 4 m in height, and is also cross or self pollinating, depending on the species grown.

Cuphea originated from central regions of the Americas especially Mexico. Cuphea is currently grown in many third world countries as well as the USA. Due to its lack of frost tolerance it is unlikely to be suitable for culture in many parts of Europe, however several species experimented with by Röbbelen and Hirsinger [1] species identified with potential for cultivation in central Europe include:

Cuphea paucpetala, Cuphea leptopoda, Cuphea wrightii, Cuphea tolucana, Cuphea lanceolata, Cuphea procumbens, Cuphea micropetala, and *Cuphea ignea.*

Details of Quality Characteristics

Cuphea is seen as a temperate region source of C8, C10, C12 and C14 oils (medium length fatty acids), to end dependence on palm and coconut oils. In Europe, best cropping results may be achieved in the Mediterranean countries.

Table 1 illustrates the diversity in fatty acid composition available in Cuphea germplasm. While there is some variation from accession to accession, the table shows species that are rich in specific single fatty acids. *Cuphea painteri*, for instance, is very rich in caprylic (8:0) acid (73%) while *C.carthagenensis* has lauric acid (12:0), as its major fatty acid (81%). *Cuphea koehneana* is probably the best example of a monoacid seed oil, with more than 95% of its acyl groups as capric acid. As a source for lauric acid, Cuphea ssp. have more to offer than coconut oil (Table 1), because the concentration of lauric acid in the oil is potentially much greater. Isolation of single fatty acids should be easily accomplished and tailor-made fatty acid compositions should be possible.

The diversity in fatty acid composition available in Cuphea germplasm: Distribution (%of total fatty acids)

Species	8:0 Caprylic	10:0 Capric	12:0 Lauric	14:0 Myristic	Others
C. painteri	73.0	20.4	0.2	0.3	6.1
C. hookeriana	65.1	23.7	0.1	0.2	10.9
C. koehneana	0.2	95.3	1.0	0.3	3.2
C. lanceolata	87.5	2.1	1.4	9.0	0.0
C. viscosissima	9.1	75.5	3.0	1.3	11.1
C. carthagenensis	5.3	81.4	4.7	8.6	0.0
C. laminuligera	17.1	62.6	9.5	10.8	0.0
C. wrightii	29.4	53.9	5.1	11.6	0.0
C. lutea	0.4	29.4	37.7	11.1	21.4
C. epilobiifolia	0.3	19.6	67.9	12.2	
C. stigulosa	0.9	18.3	13.8	45.2	21.8
Coconut	8.0	7.0	48.0	18.0	19.0

Content of amino acids in *Cuphea painteri* (g/16g of protein)

Amino acids in *Cuphea painteri*	Content (g/16 g protein)
Aspartic acid	8.0
Threonine	3.0

Serine	4.9
Glutamic acid	15.3
Proline	3.5
Glycine	4.5
Analine	3.9
Valine	4.6
Cystine	1.2
Methionine	1.7
Isoleucine	3.9
Leucine	6.2
Tyrosine	2.7
Phenylalanine	3.8
Lysine	3.9
Histidine	2.2
Arginine	10.2

Source: http://www.hort.purdue.edu/newcrop/proceedings1990/v1-196.html

Triglyceride analysis of *C. lanceolata* shows that the combination of acyl groups within triglyceride molecules is not the result of random distribution but the specific combination of certain fatty acids, particularly C10. Gas chromatography of the intact triglycerides show that the C8 was completely contained in the group with carbon number of C28 indicating that the C30 peak was made up of three C10 fatty acids and not a combination of C8, C10, and C12. These combinations have significance when Cuphea oils are to be used in nutritional and medical applications.

Current Production and Yields

Currently only Italy and the Netherlands are showing any scientific interest/ development in the growth of Cuphea sp. However, many species from the genus Cuphea have potential as sources of medium chain triglycerides (Wilson et al. 1960, Miller et al. 1964, Wolf et al. 1983, Graham and Kleiman 1985, Graham et al. 1981). However, Cuphea is only a few years from the wild and still has the characteristics of a wild plant. Those characteristics that differ from cultivated plants are its propensity to seed shatter, its indeterminate flowering nature, and its overall stickiness. If these wild traits can be overcome, Cuphea's chemistry, coupled with the annual and therefore renewable nature of the plant, certainly can make it a new crop.

Germination in central European climate is slow (14-20 days) even in late May after the last frosts, but this is made up for by quick growth and early seed ripening. Germination is slowed by the thick seed hull. The first seed is produced six weeks after sowing in the greenhouse.

Constraints upon Production

Due to its lack of frost tolerance, and the unreliability of the weather during the harvest period, Cuphea spp are unlikely to be suitable for culture in many parts of Europe.

Until now, Cuphea has not been commercially utilised in large scale agriculture due to its characteristic, sequential maturation and release of oil seeds from the seed pods, which precludes mechanised harvesting. Cuphea is generally harvested by hand at present. Technology which would allow the cultivation and harvesting of Cuphea using modern agricultural methods would have the potential to create a new, high-value, oil-seed crop of major industrial importance. These problems with seed shattering, stickiness and dormancy are now being overcome by plant breeders.

Markets and Market Potential

Members of the Cuphea genus produce an oil rich in medium-chain triglycerides, such as lauric acid and capric acid. Industrial oils made from these acids are valuable commodities as they have the potential to replace others made from imported palm kernel and coconut oil. Lauric acid is used in foods, mostly as vegetable shortenings, as a defoaming agent and a booster for soaps and detergents.

Medium chain length fatty acids (e.g. lauric and myristic) are used in detergents and health and beauty products. Statistics show that 71,000 tonnes of lauric acid oils were processed during 1991 in the EC; they originated from Copra (i.e. coconut) and Palm kernel. (1)

Cuphea has been used as an alternative to coconut oil in soaps, detergents and other products (NCAUR. National Center for Agricultural Utilisation Research. (18 –7-01).

Other Information

In the US it has been suggested to plant Cuphea in rotation with corn and soybeans every three years. If grown this way Cuphea can help disrupt the life cycle of corn rootworms - pests that account for more pesticide use on US row crops than any other insect. (Corn rootworms can cost up to $1billion per annum in control and yield losses)

Research

Method for improving Cuphea oil seed production by eliminating premature pod shattering.

A UCSD scientist has discovered a transgenic construct that suppresses seed pod shattering in the laboratory by constitutively expressing a gene in *Arabidopsis thaliana* that appears to be necessary and sufficient expression of the dehiscence zone and subsequent valve opening. The gene is fully expressable in other species. Seed shattering can be delayed or stopped completely by altering the expressions of this gene. Applied specifically to the construction of transgenic Cuphea displaying severe delay of natural pod shattering, this invention has the potential to yield for the first time a practical crop technology for modern commercialization of this species, and economical exploitation of its high value oil.

(Source: http://www.invent.ucsd.edu/tech_available/cases/98-063.htm)

Developing oils through genetic engineering.

Steven J Knapp and Mary B Slabaugh 1998.

Further plant engineering research carried out at Oregon State in 1998 demonstrated that synthases and thioesterases are both necessary and sufficient to reproduce the fatty acid composition found in Cuphea. It also shows that synthase genes can be used to alter fatty acid composition in crop plants. Discoveries resulting from this study could benefit agriculture by facilitating creation of foods and medicines as well as supplies of novel industrial chemicals for soaps, detergents, diesel fuels, lubricants and plastics. An important application is also expected in future decades as petrochemical supplies dwindle, prices rise, and the importance of seed oils as sources of industrial chemicals and fuels increases. Crop plants engineered with Cuphea could play a major role in supplying replacements for these raw materials. (Source: http://www.reeusda.gov/nri)

Useful Websites

http://www.hort.purdue.edu/newcrop/proceedings1990/v1-196.html - Chemistry of new oilseed crops

http://www.invent.ucsd.edu/tech_available/cases/98-063.htm

http://www.reeusda.gov/nri - National Research Initiative Competitive Grants Program: Developing oils through genetic engineering

BioMat Net

Cuphea (Cuphea spp.)

AGRE-0039 - Seed Oils for New Technical Applications SONCA

Crops for Detergents

Crops for Fine Chemicals

AIR3-CT94-2003 - Sunflower Oil For Industrial Applications - SOFIA

FAIR-PL97-3884 - CTVO-NET Chemical-technical utilisation of vegetable oils

Contacts

References

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4. Miller, R.W., F.R. Earle, I.A. Wolff, and Q. Jones. 1964. Search for new industrial oils. IX. Cuphea, a versatile source of fatty acids. J. Amer. Oil Chem. Soc. 41:279-280.

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7. Steven J Knapp and Mary B Slabaugh, Oregon State University. 1998. in NRI research highlights July. http://www.reeusda.gov/nri/pubs/highlights/jul98/jul98.htm