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RESEARCH ARTICLE

LATICIFEROUS PLANTS : RENEWABLE SOURCES OF ENERGY

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ABSTRACT

Systematic search for plants with hydrocarbon contents was carried out during present investigations. A large number of plants were surveyed for their hydrocarbon contents and suitable species were determined for mass production. Agro technology has been developed.

INTRODUCTION

Systematic search for plants with hydrocarbon contents has been made sporadically in the past. Initial studies on latex bearing plants were confined to the rubber yielding plants. However, during the second world war considerable interest was generated for alternative energy sources for fuel and rubber (Hall, 1980). Buchanan *et al.* (1978a, 1978b) surveyed 100 plants species from Illinois, for natural rubber as well as "oil" content and developed selection criteria for identifying potential plant species. Species were rated in four categories on the basis of their uses such as fibre, protein, oil and rubber production. Oil and rubber contents were determined by extraction of dried plant material with various solvents. In this survey 14 species were identified, with were judged to have good potential as hydrocarbon and rubber-producing crops according to the criteria of Buchanan and co-workers (1979). The most promising species belonged to *Euphorbiaceae, Asclepiadaceae* and *Compositae*. The United States Department of Agriculture (USDA) researchers screened 6,500 species of wild plants for oil producing plants (Earle and Jones, 1962 and Stewart *et al.,* 1981). McLaughlin and Hoffman (1982) conducted a survey of over 400 samples of plants from the south U.S.A. The plant collection encompassed considerable taxonomic diversity; 195 species belonging to 107 genera and 35 families were examined for hydrocarbon or chemical feedstock. 10 species were identified by the Arizona selection criteria as having high potential for further development: *Pedilanthus macrocarous* (Euphorbiaceae), *Asclepias albicans, A. subulata* and *A. erosa* (Asclepiadaceae), *Amsonia grandiflora* and *A. kearnevama* (Apocynaceae), *Crysothamnus paniculatus, C. nauseous, Grindelia camoorum,* and *Xanthocephalum gymnospermoides* (Compositae). 2 species in the family *Asciepiadaceae*: *Calotropis procera* and *Asclepias syriaca* have been investigated as potential sources of hydrocarbon like materials. *C. procera* has been reported as hydrocarbon yielding crop by several workers (Erdman and Erdman, 1981; Williams, 1981; Williams and Home, 1983; Williams *et al.,* 1981 and Peoples and Lee, 1982). Campbell (1983) assessed the chemical and agronomic variations present in *Asclepias syriaca,* the common milkweed in Maryland and northern Virginia. Earlier Adams (1982) had reported on the yield of *A. syriaca.* A project on *Euphorbia tirucalli* was also initiated in Kenya (Leaky, 1982 and Dosaji, 1983). Bhatia and Srivastava (1983) screened 386 indigenous laticiferous plants belonging to families *Euphorbiaceae*, *Asclepiadaceae*, *Apocynaceae*, *Urticaceae* (Moraceae). *Convolvulaceae* and *Sapotaceae* and resulted in selection of sixteen potential plants for further studies. The present investigations were undertaken to screen locally occurring hydrocarbon yielding plants. Some plants were also collected from National Botanical Research Institute (NBRI) Lucknow, *E. lathyris* plants were raised from seeds obtained from Spain.

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MATERIALS AND METHODS

During the present investigations two species of family *Asciepiadaceae* and seven of *Euphorbiaceae* were screened for the organic extractables using acetone-benzene and hexane-methanol extraction products. The hydrocarbon yields were calculated on per cent dry weight basis. The selected plants were collected as follows: *Calotropsi gigantea* (Linn.) R. Br. from Chittorgarh, *C. procera* (Ait.) R. Br. from Jaipur, *Euphorbia antisypbilitica* Zucc. from NBRI, Lucknow, *E. neriifolia* Linn. from Chandwaji region, Jaipur, *E. nivulia* Buch Ham. from Jaipur, *E. tirucalii* Linn. from Maharaja's College, campus, Jaipur and *E. hirta* Linn. from the University campus, Jaipur. *E. lathyris* Linn. was raised from the seeds, received from Prof. Ayerbe, Spain. Three varieties of *Padilanthus tithymaloides* (Linn.) Poit – *P. tithymaloides* var-green, *P. tithymaloides* var. *variegatus,* and *P. tithymaloides* var. *cuculatus* were obtained from Jaipur.

RESULTS

The detailed characteristic features of selected species are given below.

***Calotropis gigantea* (Linn.) R. Br. (*Asclepiadaceae*).**

It is commonly called as Kapal-Kapal (Philippines), Ivory plant (English), Widori (Indonesia) AK (India). The species is common in India, Ceylon, Malaya Islands, South Chaina, Philippines, Indonesia, Singapore, Thailand and the lesser Sunda Islands. In India, it occurs in tropical Himalayas, usually growing in open waste lands. It is found in Khasia hills, Konkan, Deccan, Gujarat, Rajasthan, Karnataka, and on the foot hills of Siwalik and Tarai plains. The plant has medicinal importance. All parts of the plant when dried and taken with milk act as a good tonic, expectorant and enthelmintic. The milk is acrid, useful in leprosy, scabies, ringworm of the scalp, jules and eruption on the body, oil, in which the leaves have been boiled is applied to paralyzed parts. A powder of the dried leaves is dusted upon wounds to destroy excessive granulation and to promote healthy action. The plant is a popular remedy for snake-bite and scorpion sting. A proteolytic enzyme, somewhat similar to papain, has also been found in the milky juice (Anonmyous, 1982).

***Calotropis procera* (Ait.) R.Br. (*Asclepiadaceae*)**

In India, it is called as Safed Ak. It is widely distributed in arid to semi-arid regions of the Caribbean, Central America, South America (Little *et al.,* 1974). Africa and South-east Asia (Mahmoud *et al.,* 1979; 1979b) and Isreal (Karschon, 1970). In India it occurs throughout. *C. procera* grows abundantly without management and survives well under harsh conditions such as high temperature and limited surface water supply (Karschon and Pinchas, 1969). The plant is also very resistant of fire (Kirschon, 1970). *C. procera* is a source of fibre (Chevalier, 1946), ruminant feedstuff (Canella *et al.,* 1966 and Mahmoud *et al.,* 1979a), medicinal drug preparation (Garg, 1979), and microbial inhibitor (Shukla and Murti, 1961 and Khurana and Singh, 1972).Williams *et al.* (1981) worked on yield of *C. procera* in the semi-tropical areas of northern Australia and estimated that up to 20 tonnes per hectare of dry biomass may be obtained from natural plants with established root systems and using two cuttings per annum. With an average yield of 20 tonnes of dried material/annum/ha having around 5 per cent hydrocarbons, seven barrels of hydrocarbon fuel per hectare may be obtained (Williams *et al.,* 1981). Peoples and Johnson (1980) reported a production of 14,800 kg dry matter/ha and 6.6 bbl. bio-crude/ha from four-year plantation of *C. procera* with planting density of 10,000 plants/ha.

***Euphorbia antisyphilitica* Zucc. (*Euphorbiaceae*)**

It is commonly called candelilla and is native to Mexican desert. It is a source of commercial candelilla wax found as thin film on stem surface giving it whitish look. Plant contains with latex which is rich in hydrocarbons. It can be easily multiplied in arid and semi-arid regions for wax. Refined wax can be used for polishes, creams, leatherware, furniture, sealing waxes, and chewing gums. It has been introduced from Mexico and is successfully established in arid parts of Rajasthan. The wax content varies from 2 to 5 per cent and can be harvested any time during the year (Paroda *et al.,* 1986).

***Euphorbia hirta* Linn. (Synonym. *Euphorbia pilulifera*) (*Euphorbiaceae*)**

It is commonly called as Bambanilag, Botobotonis saika, Bolobotonis, Magatas, Malis-malis, Sisiohan, Bobi Totaba, Pansi-pansi, Soro-soro, Patik-patik, Piliak, Tairas, Tauataua, Teta (Phillippines), astham weed (Australia), snake weed, cat's hair (English). Patikan (Indonesia) and Golondrina (Spanish), Dudhi (India). It grows throughout the Indian in waste lands and open grasslands and is usually very abundant. It is also abundant in Sri Lanka, Thailand, Indonesia, Malaysia, Nepal and Philippines. It is pantropic. The plant has some medicinal properties.

***Euphorbia lathyris* Linn. (*Euphorbiaceae*)**

Commonly called as caper spurge, gopher plant and mole plant (English). This plant grows throughout the temperature areas of the world, preferring open, relatively mesic habitats. In California, it grows along the coast. In Australia, it has naturalized in the vicinity of Sydney and Melbourne, in the humid south-east, but occur in the arid south-west. Plant by-products have some commercial and medicinal importance.

Euphorbia neriifolia Linn. (Synonym – *E. ligularia, E. pentagona*) (*Euphorbiaceae*).It is commonly called as Indian sugare, suda-suda (Philippines), and susura (Indonesia). It grows throughout the Phillippines in waste lands, open grass lands and is usually very abundant. It is also abundant in Sri Lanka, Thailand, Indonesia, Malaysia, Nepal and India. In India, it grows throughout and extends to Malaya. Occasionally, it is cultivated for ornamental purposes. It is very common on rocky places of Rajasthan, Konkan and Deccan peninsula, in the Siwalik tract of north-western Himalayas and Gujarat, Ahmadnagar and Bijapur districts in western peninsula. Poor looking plants also occur in dry barren soils in Bengal (Srivastava, 1986). It can grow in semi-arid regions. It also has medicinal importance (Anonymous, 1982).

***Euphorbia nivulia* Buch. Ham. (*Euphorbiaceae*)**

It is found in North-west Himalayas, on dry rocky hills of Gujarat and Deccan peninsula. It occurs in barren and rocky places of Rajasthan, Bihar, U.P., Gujarat and Southern states of Mysore, Madras and Kerala.

Euphorbia tirucalli **Linn. (*Euphorbiaceae*)**

Its common names are Stick plant, African milkbush (English), Consuelda (Spanish), Suerda, Pobreng Kahoy (Phillippines), Kayu urip (Indonesia) Paya-raibia (Thialand), Sehund and Konpal (India). A native of Africa, this species is now planted in most tropical countries. It is common in Brazil, Africa, Israel, some semi-arid lands and in the drier western parts of Bengal, Bihar, Punjab, Puri and South India (Srivastava, 1986). It also does not require good soil and grow well in uncultivated areas which are not suitable for food crops (Anonymous, 1982). It is vegetatively propagated through cuttings. It can grow in semi-arid regions where rain fall is about 25 to 50 cm per year (Anonymous, 1982). It yields any components which may have higher values as pharmaceuticals.

Pedilanthus tithymaloides **(Linn.) Poit (*Euphorbiaceae*)**

It is commonly called as Zig zag plant (English), Patah (Indonesia) and Solsoldong (Philippines). The plant, a native of Maxico, is now cultivated for ornamental purposes in most tropical and sub-tropical countries (Anonymous, 1982). In India, it is also known as red bird cactus or slipper flower. They are hardy and adaptable to wide variety of soils and tolerate various degrees of water application (Srivastava *et al.,* 1985). It does into required good soil and grows well in uncultivated areas and dry locations (Anonymous, 1982). It is vegetatively propagated. In India 7 different varieties of *Pedilanthus* are cultivated as ornamental or hedge plants. Considerable differences were recorded in per cent dry weight and hydrocarbon contents in various plant species investigated (Table 1). The per cent dry weights ranged from 8.8 per cent (*E. tirucalli*) to 22.63 per cent (*E. lathvris*). In others the yield was *Calotropis gigantea* (22.0 per cent), *Euphorbia hirta* (20.0 per cent), *Calotropis procera* (16.8 per cent), *Pedilanthus tithymaloides* var. *cuculatus* (15.7 per cent), *P. tithymaloides* var. *variegatus* (15.5 per cent), *P. tithymaloides* var. *green* (14.7 per cent), *Euphorbia neriifolia* (11.59 per cent), *E. nivulia* (11.3 per cent) and *E. antisyphilitica* (10.57 per cent).

REFERENCES

Arnon, D.I. 1949. Copper enzymes in isolated chloroplasts. Polyphenoloxidase in *Beta vulgaris. Plant Physiol.,* 24 : 1-15.

Bernstein, L. and H.E. Hayward, 1958. Physiology of salt tolerance. *Ann. Rev. Plant Physiol.,* 9 : 25-46.

Bhatia, V.K., K.G. Mittal, R.P. Mehrotra and M. Mehrotra 1986. Hydrocracking of biocrudes for maximising middle distillates. In Proc. Petro-crops workshop. Dec. 20-21., New Delhi (In Press).

Bhatia, V.K. and G.S. Srivastava (1983). Introduction screening and cultivation of potential petro-crops and their conversion to petroleum hydrocarbons. Progress Report phase-I, pp. 94.

Bhatia, V.K., G.S. Srivastava, V.K. Garg, Y.K. Gupta and S.S. Rawat, 1984.0 Petro-crops for fuel. *Biomass*, 4 : 151-154.

Buchanan, R.A., I.M. Cull, F.H. Otey and C.R. Russell, 1978b. Hydrocarbon – and rubber – producing crops. Evaluation of 100 U.S. Plant species. *Econ. Bot*., 32 : 146-153.

Calvin, M. 1976. Photosynthesis as a resource for energy and materials. *Photochem. Photobiol.,* 23 : 425-444.

Calvin, M. 1977. Hydrocarbons via photosynthesis. *Energy Res.,* 1 : 299-327.

Calvin, M. 1978a. Green factories. *Chem. Eng. News*, 50 : 30-36.

Calvin, M. 1979a. Petroleum plantations for fuel and materials. *Bioscience*, 29 : 533-537.

Calvin, M. 1979b. Peteroleum plantations. In Solar Energy : Chemical conversion and storage (Ed.) R.R. Hautalona, A.B. King and C. Kutal. Human Press, Clifton, N.J.

Calvin, M. 1980. Hydrocarbons from plants : analytical methods and observations. *Die Naturwissen*, 67 : 525-533.

Calvin, M. 1983a. New sources for fuel and materials. *Science*, 219 : 24-26.

Calvin, M. 1983b. Oil from plants. *Photochem. Photobiol*., 37 : 349-360.

Calvin, M. 1984. Revewable fuels for the future. *J. Appl. Biochem*., 6 : 3-18.

Calvin, M. 1985. Fuel oils from higher plants. *Ann. Proc. Phytochem. Soc. Eur.,* 26 : 147-160.

Clavin, M., E.K. Nemethy, K. Redenbaugh and J.W. Otvos, 1981. Plants can be direct source of fuel. *Petroculture*, 2 : 26.

Clavin, M., E.K. Nemethy, K. Redenbaugh and J.W. Otvos, 1982. Plants as a direct source of fuel. *Experientia*, 38 : 18.

Chopra, R.W., S.L. Nayar and I.C. Chopra, 1956. Glossary of Indian medicinal plants. Council of Scientific and Industrial Research, New Delhi, India.

Coffey, S.G. and G.M. Halloran, 1979. Higher plants as possible sources of petroleum substitutes. *Search*, 10 : 423.

Coffey, S.G. and G.M. Halloran. 1981. *Euphorbia perspectives* and problems. In. Proc. Natl. Conf. on Fuels from Crops, Melbourne, Australia Sep., 28-29.

Dalal, M. 1984. Bio-energy : present status and future prospective. In. Proc. Bio-Energy Soc. first convention and symposium '84. (Ed.) R.N. Sharma, O.P. Vimal and P.D. Tyagi, Bio-Energy Soc. of India, New Delhi, 12-24.

Dayal, M. 1986. Production and utilization of petro crops. In. Pro. Work-shop on petro-crops. Dec. 20-21, Delhi.

Dhir, R.P. and S.V. Jain, 1982. Morphology, genesis and classification of desert soils. Proc. 12th International Congress of soil science : Review of soil research in India, II : pp. 474-483.

Dosaji, S.F. 1983. *E. tirucalli* L. its potential as a renewable energy crop. A report on the *Euphorbia* project, Kenya Govt.

Hall, D.O. 1980. Renewable resources, hydrocarbons. Outlook Agric. 10 : 246-254.

Hall, D.O. 1982. Food versus fuel, A world problem ? In Proc. Energy from biomass and E.C. Conference. (Ed.) Strub, A.P. Chartier and g. Schlesser Applied Science Publishers, London and New York, pp. 43-62.

Held, W., M. Peters, C. Buhs, H. Oelert, C. Reifenstahl, and C.F. Wagner, 1985. Production of hydrocarbons from biomass, Venice, Italy, 25-29 March.

Hinman, C.W., J.P. Hoffman, S.P. McLaughlin and T.R. Peoples 1980. Hydrocarbon production from arid plant species. In Proc. Ann. Meeting of Am. Section Int. Solar Energy Soc. In., Navark, DE.

Hoffman, J.J. 1983. Arid land plants as feedstocks for fuels and chemicals. *Plant Science*, 1 : 95-116.

Johnson, J.D. and C.W. Hinman 1980. Oils and rubber from arid land plant. Science. 208 : 460-464.

Khoshoo, T.N. 1982. Energy from plants : Problems and prospects, Proc. 69th Ind. Sci. Congr. II, 1.

Khoshoo, T.N. 1984. Bio-energy : Scope and limitations. In Proc. Bio-Energy Soc. Ist Convention and symposium, '84. (Ed.) R.M. Sharma, O.P. Vimal and P.D. Tyagi, Bioenergy Society of India, New Delhi pp. 4-11.

Kingsolver, B.E. 1982. *Euphorbia lathyris* reconsidered its potential as an energy crop for arid lands. *Biomass*, 2 : 281-298.

Kumar, A. 1984. Hydrocarbon from plants in arid and semi-arid regions. IN : Proc. National Seminar on Application of Science and Technology for Afforestation. ACT. pp. 81-86.

Kumar, A. and P. Kumar 1985. Agronomic studies on growth of *Euphorbia lathyris.* In : Bio-energy 84. II. Biomass (Ed.) H. Egneus and H. Ellegard Elsevier Applied Science. Publishers, London, pp. 170-175.

Kumar, A. and R. Kumar 1986. Improving the productivity of petro-crops in Rajasthan. In Proc. Bio-Energy Soc. IInd Convention and Symposium '85. (Ed.) R.N. Sharma and O.P. Vimal. Bio-Energy Soc. of India. New Delhi, pp. 125-129.

Lewis, C.W. 1981. Biomass through the ages. Biomass 1 : 5-15.

Lipinsky, E.S. 1981. Chemicals from biomass : petro-chemicals substitution opitions. *Science*, 212 : 1465.

McLaughlin, S.P., B.E. Kingsolver and J.J. Hoffman 1983. Biocrude production in arid lands. Eon. Bot. 37 : 150-158.

Metcalfe, C.R. 1967. Distribution of latex in plant kindom. *Econ. Bot.,* 21 : 115-127.

Murty, K.S. 1985. Bioenergy programme in India. In : Bio-Energy 84. IV. Bio-Energy (Ed.) H. Egneus and A. Ellegard. Elsevier Applied Science, Publishers, London, pp. 385-393.

Nemethy, E.K. 1984. Biochemicals as an energy source. CRC *Critical Reviews in Plant Sciences,* 2 : 117-129.

Nemethy, E.K., J.W. Otvos an M. Calvin, 1978. Analysis of extractables from one *Euphorbia*. *J. A. Oil. Chem. Soc.,* 55 : 647.

Nemethy, E.K., J.W. Otwos and M. Calvin 1979. Analysis of extractables from one *Euphorbia. J. Amer. Oil Chem. Soc.,* 56 : 957-960.

Nemethy, E.K., J.W. Otvos and M. Calvin. 1981a. Hydrocarbons from *Euphorbia lathyris. Pure Appl. Chem.,* 53 : 1001.

Nielsen, P.E., H. Nishimura, J.W. Otvos and M. Calvin. 1977. Plant Crops as a source of fuel and hydrocarbon-like materials. *Science*, 198 : 942-944.

Paroda, R.S., T.A. Thomas and R. Singh 1986. Genetic Resources of Petro-Crop in India. In Proc. Petro-crop workshop. Dec. 20-21, New Delhi.

Peoples, T.R. and J.E. Johnson. 1980. Crop alternatives in semi-arid regions. In Proc. Nat. Res. and Regional Dev.: The Care of the Semi-arid Region, Cocoyoc, Mexico, October 6-8.

Prokhanove, Y.E. 1949. *Euphorbia.* Flora U.S.S.R. 14 : 233-378.

Raychaudhuri, S.P. 1978. Soils of India with special Reference to Arid-zone. In : Proc. Arid zone Research in India. Cazri. pp. 109-116.

Sachs, R.M., C.B. Low, J.B. McDonald, A.R. Award and M.J. Sully, 1981. *Euphorbia lathyris* : A potential source of petroleum like products. California Agriculture. July-August, pp. 29-32.

Sachs, R.M. and T. Mock. 1980. *Euphorbia lathyris* : A preliminary guide to planting. Agri. Expt. Station Servie. University of California, Davis, Report No. 103.

Singh, N.T. and V.S. Tomer. 1982. Soil-water plant relationship. In Proc. 12th International Congress of Soil Science : Review of soil research in India, Part I : pp. 3-27.

Srivastava, G.S. 1985. Availability and production of petro-crops in India. In Proc. Natl. Seminar-cum-workshop on Bio-Energy Education (Ed.) H.M. Behl and O.P. Vimal. Rahul and Co., pp. 68-89.

Srivastava, G.S. 1986. Petro-Crops, their availability and cultivation. In : Proc. Petro-crop workshop Dec. 20-21, New Delhi.

Srivastava, G.S. and V.K. Bhatia, 1986. Potential petro-crops in India – a critical review. In : Proc. Bio-Energy Soc. IInd Convention and Symposium '85. (Ed.) R.N. Sharma and O.P. Vimal. pp. 119-124.

Srivastava, G.S., V.K. Bhatia, K.C. Bubey and S.S. Baghel. 1981. Potential of plant biomass as a source of hydrocarbons. In : National Seminar on materials for advanced energy systems. IIT. Kanpur, 17-19Dec.

Srivastava, G.S., V.K. Bhatia, K.C. Dubey and V.K. Garg. 1985. Potential of *Pedilanthus tithymaloides* as a petro-crop. *Fuel*, 64 : 720-721.

Stewart, G.A., J.S. Hawker, H.A. Nix, W.H.M. Rawlins and L.R. Williams. 1982. The potential for production of hydrocarbon. Fuel from crops in Australia, A report, pp. 86.

Szego, G.C. and C.C. Kemp. 1973. Energy forests and fuel plantations. *Chem. Tech.,* 3 : 275.

Tebicke, H.L. 1985. Bio-Energy research and development in developing countries. In : Bio-Energy 84. V. Bio-Energy in developing countries. Elsevier Applied Science. Publishers, London, pp. 186-191.

Tideman, J. and J.S. Hawker, 1981. The hydrocarbon content of some latex bearing plants in Australea, *Search*, 12 : 364.

Vergagara, W. and D. Pimental, 1978. Fuels from Biomass : comparative studies of the potential in five countries USA, Brazil, India, Sudan and Sweden. *Adv. Energy Syst. Technol.,* 1 : 125.

Vimal, O.P. 1986. Stategies for use of petro-crops. In Proc. workshop on Petro-crops. Dec. 20-21, Delhi.

Vimal, O.P. and P.D. Tyagi, 1984. Energy from biomass. Agricole Publishing Academy, New Delhi, pp. 440.

Waird, R.F. 1982. *Euphorbia* is it the source of hydrocarbons in the future ? *Solar Energy*, 29 : 83-863.

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