CHAPTER 1

GENERAL INTRODUCTION

*Pogostemon cablin* Benth. syn. *Pogostemon patchouli* Pellet. is a tropical, aromatic, herbaceous perennial, that belongs to the family Lamiaceae. It is commonly called the patchouli plant (Guenther 1949). The shade dried leaves of the plant on steam distillation yield an essential oil called the patchouli oil of commerce (Caius 1986). Patchouli oil is carried in the glandular trichomes on the adaxial surface of leaves. The glandular hairs are small with a short single celled stalk and double celled head (Weiss 1997), (Fig.1b). The stem, floral tops and roots also possess oil glands. But the oil obtained from them is of an inferior quality when compared to the oil of leaves. The second pair of primordial leaves is reported to carry glandular trichomes containing a sesquiterpene concentration twelve times higher than that in any other part of the plant (Henderson *et al.* 1970). Unlike other oils of Lamiaceae, patchouli oil is unique, because it consists of twenty four different sesquiterpenes rather than a blend of different mono, sesqui and diterpene compounds (Denguerry *et al.* 2006). This feature imparts tenacity of odor to patchouli oil which is the reason for its versatile use.

1.1. History of Patchouli

The word “Patchouli” seems to be derived from the Hindustani “Pacholi”. In the 1740’s, precious Indian fabrics and shawls used to arrive in Europe permeated with a strange odor which was considered characteristic and proof of oriental origin. It was only when the first shipment of dried patchouli leaves arrived in London about 1844,
Fig. 1 Oil glands on the patchouli leaf epidermis (a) 40x (b) 400x
that the long sought-after secret of the mysterious scent was revealed. Many historians speculate that, its association with opulent eastern goods like silk is the reason why patchouli was considered by Europeans to be a luxurious scent. In Europe and the United States, patchouli oil and incense underwent a surge in popularity during 1960’s and 1970’s among the devotees of free love and hippie lifestyles since the pungent smell of patchouli was alleged to mask the smell of burnt cannabis and body odor. The essence of patchouli has been a traditional ingredient of love potions from time immemorial and remains a very popular scent to date.

The patchouli plant was first technically described in 1845 by Pelletier Sautelet and named *Pogostemon patchouli*. It was identified as a native of the Philippine islands in 1896 (Holmes 1913). The word cablin was derived from “cablam” the vernacular name of the plant in Philippines.

There is no substitute reported till-date for natural patchouli oil since it has a characteristic oriental odor that is balsamic, spicy, sweet, aromatic, woody and minty. Organic patchouli essential oil has a long history of use in the fields of medicine, perfumery, rituals, and cosmetics as it has stood the test of time for its safety, efficacy, versatility, cultural acceptability and environment friendly properties.

1.2. Uses of Patchouli

The patchouli leaves are used along with clothes stored in the wardrobe since they deter insects like flies, ants, moths, gnats and mosquitoes (Nadkarni 1972). They are also used as a leech repellent and remedy for poisonous insect bites. In combination
with other drugs, patchouli is prescribed as an antidote to snake and scorpion venoms (Kirthikar and Basu 1991). Cultivation of this plant outside houses also helps to keep mosquitoes at bay.

The fresh leaves of the plant possess anti-microbial, diuretic, regenerating and rejuvenating properties. Therefore, it is used in Ayurveda, Indian traditional medicine, Chinese medicine (Agarwal 1985; Akhila and Tiwari 1984), and alternative therapies. The fresh leaves are used to prepare a decoction with other drugs to treat nausea, vomiting, diarrhea and abdominal pain (Akhila and Thakur 1988). Japanese researchers tested eight traditional Chinese herbs to see how well they reduce nausea and vomiting. Patchouli alcohol in patchouli oil was reported to be the most active. It worked 58% better than the controls. Patchouli is reported to control muscle spasm of the digestive tract (Yang 1999). In Ayurveda, patchouli is used as an equivalent to taleespatram. It is commonly called pathram, pathrakam and pathranamakam, in Sanskrit. It is used in many balms and is an unavoidable ingredient of many kashayams (decoction), alcoholic medicaments, distillations, linctus, medicated oils, powders, fine powders, snuffs, medicated sticks, pills and tablets. It is also administered in gastro intestinal problems, peptic ulcer, hyperacidity, indigestion, gas trouble and vaginal disorders. An infusion of the leaves in water (1:10) in doses of half to one fluid ounce is administered as a diuretic and carminative. It is used with tulasi seeds in scanty urine and biliousness (Nadkarni 1972). The extract of the leaves is given in cough and asthma. An infusion of this plant is also given for menstrual troubles. Fresh leaves are used to make styptic pastes. They are also applied as a cataplasm to clean wounds and to promote healthy granulation. Its powder is used as sternutatory and yield antiseptic oil. The
root of the plant is given in dropsy (Agarwal 1985). The other ayurvedic preparations in which patchouli is used include, *Lodhrasavam*, *pootheekaranjasavam*, *bala thailam*, *madhuyashtyadi thailam*, *amruthaprasaghritam*, *kooshmanda rasayanam*, *dadimashtaka choornam*, *thaleesapatradivatakam*, *patoladi choornam*, *yavanathi choornam*, *chathurjatha choornam*, *bhrakshadi choornam*, *arivavathi oil*, *chandanathi oil*, *thriphalathi oil*, *elathi oil*, *chyavanaprasam*, *dashamoolarishtam* and *pippalyasavam*.

Patchouli oil has found widespread use in modern industry despite its common association with an alternative lifestyle. It is a component of one third of the modern high end perfumes including more than half of the perfumes for men. Its base-note and excellent fixative properties make it an important ingredient of many famous perfumes like “Tabu” and “Shocking”. Since it mixes well with other essential oils like vetiver, sandalwood, frankincense, bergamot, cedarwood, myrrh, jasmine, rose, citrus oil, lavender and clove oil (Arctander 1960), it is also used to fix many other perfume formulations. There is no synthetic chemical to replace the oil of patchouli, which further enhances its value and unique position in the perfumery market. The oil also gives one of the finest attars when blends with sandalwood oil. It is also used to perfume agarbatti and candles and is made use of extensively by the incense industry. *Pogostemon cablin* Benth. was grown in China two thousand years ago and is reported to have given the distinctive smell of original Indian ink and Chinese red ink paste.

Patchouli oil is used as a flavor ingredient in major food products including alcoholic and non-alcoholic beverages, candy, baked goods, pudding, and meat products, in the cosmetic, tobacco and pharmaceutical industries due to its aromatic, flavoring
and masking nature. It is approved by the FDA for food use under para 172.510 and has been recognized as safe (GRAS No. 2838). As a flavor ingredient, the use level of oil is less than two parts per million.

There is a great demand for patchouli oil in soaps, shampoos, scents, body lotions, pre-shave and after-shave lotions, detergents, tobacco and incense manufacturing factories. It is also used to scent many foul smelling creams and as a masking agent in depilatory creams. Patchouli oil is used to treat athlete’s foot and dandruff of the hair since it possesses antifungal property. It is reported to inhibit gram negative bacteria and Candida albicans. In skin care, its regenerative, wound-healing and tissue strengthening properties work. The oil is therefore used in indications of varicose veins and as a topical remedy for skin problems like acne, eczema, inflamed, cracked, chapped and irritated skin, sores and is also known as a skin rejuvenator that helps in healing wounds and scars (Balz 1996). Patchouli oil is used as a mouthwash and against vaginal infections. The oil is proved to be active against Alternaria citri, Fusarium oxysporum, Fusarium solani, Helminthosporium compactum and Sclerotium rolfsii. It also helps to tighten loose skin, shrink enlarged pores and smooth out ageing skin. The oil is reported to absorb infra-red radiation and thus increases the circulation and oxygenation of blood. Linconchalcon A, a cyto-toxic agent from P. cablin is reported to be used in the treatment of promyelocytic leukemia cells (HL-60) (Park et al. 1998).

The oil of patchouli is used in temples in the form of incense, as it aids in grounding and centering the mind prior to meditation and connect with the natural beauty of planet earth (Valerie 1999). It is also widely used in the Chinese traditional system to balance chi or positive energy.
Patchouli oil helps to reduce tension, insomnia and anxiety, thus soothing the nervous system (Hyung et al. 2008). This coupled with its wine-like intoxicating aroma functions as an aphrodisiac (Holmes 2001). Hence, it is widely used in Aromatherapy. Perfume compositions containing patchouli oil are also reported to improve mental work efficiency (Suzuki et al. 2006).

1.3. Patchouli oil: National status

In view of the above, an excess demand of patchouli oil has always prevailed in the national and international markets. The major patchouli oil producing countries have been Indonesia (500 tons), China (60 tons), Brazil (1.5 tons) and Malaysia (1.0 ton), per annum. According to the figures of the Essential Oil Association of India, seventy one tons of patchouli oil worth rupees one hundred and sixty three lakhs was imported by India from other countries in the 1990’s. By the year 2000, the requirement rose to forty tons pure and sixty tons formulated oil (Bhasker and Vasanthakumar 2000). Reports of 2002 depicted that India’s annual requirement of patchouli oil was three hundred tons. Of this, only a negligible quantity was produced in India. One hundred tons was met by import and the remaining shortfall was fulfilled by reconstituted formulated oil. Today, the Indian demand for patchouli oil is two hundred and twenty tons per annum, a major share of which is met by imports. The North Eastern Development Finance Corporation of India has also identified immense export potential for this crop and has predicted a steady market for patchouli oil in the forthcoming twenty years (NENA Headlines 2002).

The Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow took up the task of expanding the production of patchouli oil in India since the global requirement of patchouli could not be met due to a localized production base.
(Varshney 2001). CIMAP chose fourteen villages around Siddapur town in the western ghat region of North Karnataka to be a part of the three year patchouli movement, under its Bio-village project on patchouli. Success of the project promoted patchouli cultivation in other coastal areas, interspaces and wastelands of Karnataka, Gujarat and Chattisgarh.

1.4. Rationale of the Study

Patchouli has been extensively cultivated in various Indonesian islands, The Philippines, Malaysia, China and South America for a long time. The crop was introduced for domestication in India only in the eighteenth century. But, India took two centuries to realize the potential of patchouli as a cash crop. It was only in the twentieth century that the patchouli crop came into mainstream cultivation in India. Patchouli has also been identified as a potential inter-crop for the plantations, since it has the advantage of not requiring stringent maintenance practices like weeding, tilling and loosening of soil. Intercropping trials have proved that it can be strongly recommended as an intercrop for Sesbania, Coconut (Vishwanathan et al. 1993; Srinivasa Reddy and Arunachalam 2002) and papaya (Ram et al. 1999) plantations.

Penang and Johore type patchouli were the two most popular varieties of Pogostemon cablin under global cultivation for a long time. The Penang variety was observed to produce more foliage and more oil whereas the Johore variety yielded lesser herbage and lesser oil, but a better quality oil in terms of chemical composition and odor value (Farooqui et al. 2001).

In tune with most of the patchouli cultivating regions of the world, India also adopted the Johore variety of patchouli for large scale cultivation. But, long term
and large scale cultivation of only the Johore variety and adoption of vegetative propagation methods to obtain better oil yield in a short period of time brought along with it an array of physiological problems in the patchouli crop. The first among these was a gradual shut down in the reproductive mechanism of the crop. This process set in with non-flowering of patchouli (Heffendehl and Murray 1979) followed by a decline in the agro-diversity of the crop. Repeated propagation by stem cuttings caused woodiness of the stem leading to low leaf yield and a decrease in the quality and life span of the crop. This explains the contradiction in reports regarding the number of harvests in patchouli. According to earlier reports, the first harvest of patchouli crop used to be conventionally performed after six months of planting i.e. when the plant attained a height of 0.5 to 1.0 meter. The plant tops consisting of six to eight pairs of leaves were harvested when the color of the leaves tended to turn pale. Subsequent harvests took place every four to five months till the plants were three years old. The patchouli crop therefore, exhibited a three year growth period (Guenther 1949 and Weiss 1997) as against the more recent reports which suggest that the crop dries out after one year (Samuel 2002). If this situation persists, the Johore variety is bound to become extinct.

Although spacing trials (Ramachandra et al. 2002) and trials with variation of growth regulators and their concentrations (Jadhav et al. 2003) are observed to enhance yield of the patchouli crop, the market is still unable to meet the biomass requirements of patchouli for propagation through rooted stem cuttings. About fifty thousand seedlings are required for planting in a hectare as mono-crop and twenty thousand for intercrop. In vitro tissue culture trials for large scale propagation of true to type patchouli plant material was also carried out in view of its commercial
production (Gopi and Polenin Sripal 2007) since *in vitro* derived plantlets were reported to be similar to each other in morphological characteristics, RAPD (Hembrom *et al.* 2006) and GC profiles. Gas Chromatographic studies and GC (MS) analysis of the chemical constituents of the essential oils produced by callus and cell suspension cultures also showed that essential oils obtained from these cultures contained the same major constituents as in the intact plant (Bunrathep *et al.* 2006). An increase in the commercial demand of patchouli raw material, a narrow genetic base, a localized production base, a shortage of planting material and a low regeneration capacity of the cultivar yielding good quality oil are the major limitations in its production in India. This situation also paved the way for the introduction of patchouli adulterants and substitutes into the global market. Bombay patchouli, Assam patchouli, Mysore patchouli, wild patchouli and local patchouli form a part of this growing list.

There is also a lack of consensus regarding the place of origin and taxonomic status of the patchouli plant used in different places for cultivation. The distillation and sale of an inferior quality oil from *Pogostemon heyneanus* Benth., commonly called the Java patchouli has been in practice for a long time (Holmes 1913). Java patchouli is indigenous to India and is often seen mislabeled in nurseries and sold as *Pogostemon cablin*. According to “The Index Kewensis”, *P. patchouli* Pellet. is identical with *P. heyneanus* Benth. from India and Burma, and with *P. cablin* Benth. from the Philippines. Closely related to *P. heyneanus* is *P. hortensis*, which has been grown for many generations in the gardens around Serang in the province of Bantam, Java.

However, it is unfortunate that no progress has been made in understanding the origin, domestication, phylogeny, diversity and production of patchouli in our
country. The current knowledge on vegetative growth behavior, oil yield and oil quality of patchouli is fragmentary. Therefore, there is an urgent need for studies in this field and redefine the standards of patchouli that have been set thirty years ago (Ramachandra et al. 2002) it is also imperative that a strategy be developed for expanding the genetic base of patchouli in the country. With the aim of constituting an inventory of patchouli, a study of the existing patchouli varieties and conservation of its wild relatives need to be carried out since they can form part of the primary, secondary and tertiary gene pools. A comparison of their horticultural performance, essential oil yield and quality can help in the construction of a genetic resource profile of the patchouli crop.

1.5. Objectives of the study

The objective of the study is to establish a patchouli germplasm and characterise the same based on physical, morphological and micromorphological parameters. A molecular characterisation following this would help to rule out the occurrence of duplicates and establish the taxonomic identity of patchouli cultivars that constitute the germplasm. The final germplasm obtained thus, is proposed to be evaluated for growth, yield and oil parameters in the field. The ultimate aim is to identify patchouli elites that would help in expansion of the genetic base of patchouli in the country. The study also aims at devising cultivar specific methods of propagation. The investigation proposed.

1.5.1. To collect, establish and maintain patchouli germplasm in pot cultures.

1.5.2. To characterise the patchouli germplasm based on morphological and micromorphological parameters.

1.5.3. To characterise patchouli germplasm using their RAPD profiles.

1.5.4. To evaluate patchouli germplasm through a field study.
1.5.5. To identify patchouli *elites* based on field evaluation data and GC (MS) profiles of their essential oils.

1.5.6. To device cultivar specific propagation methods for the selected patchouli *elites*.
BIBLIOGRAPHY


* Original not seen