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# Morphology, Molecular and Micropropagational Activities of *Nerium odorum* - A Review

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**Abstract:** ***Nerium (L.) is commonly known as Kaner is an important medicinal shrub of family Apocynaceae. It comprises only one species i.e. Nerium odorum. Explants of this plant cultured in vitro and has been found to retain the capacity to synthesis alkaloids identical to that in the intact plant. Alkaloids of these plants have a great medicinal importance to treat various diseases like cardiovascular diseases, indigestion, leprosy, malaria, cancer, etc. The members are wild as well as cultivated with milky saps that contain secondary metabolites which have medicinal value. It has long being used in India as rat poisoning and snake bite cure. The present review deals with the enormous amount of studies undertaken in different aspects of this plant in the areas of morphology, molecular biology and tissue culture.***

**Keywords:** Explants, Medicinal shrub, Akaloids, Cancer, Milky Sap.

## 1. Introduction

*Nerium* (L.) is an important medicinal shrub of family Apocynaceae, ubiquitous in temperate and subtropical areas (Ellenhorn and Barceloux, 1998). It comprises only one species *i.e. Nerium odorum*. Common names include soland, lorier bol, rosebay and rose laurel and kaner (Ansford and Morris, 1981). It is most commonly known as oleander, from its superficial resemblance to the unrelated olive *Olea*. (Oleander, 2013). Three varieties of this plant that is white, red and pink are mostly found in India (Frohne and Fander, 1984). Though considerable variations can be observed among these verities in garden around the world. The polymerase chain reaction (PCR) based molecular markers such as RAPD and Restriction digestion are being extensively used to study the genetic diversity in a number of plant species. It is cultivated worldwide as an ornamental plant. It is native to the Mediterranean region (Kingsbury, 1964; Hardin and Arena, 1974). In Sanskrit medical works of this plant is described as hot and poisonous. The oleander is most prevalent and alluring flowers make it a particular hazard for accidental ingestion (Ansford and Morris, 1981). The plant also has shown toxicological importance for accidents when used in folk medicines, when adults unknowingly eat parts of the plant or food that has come into contact with the plant, such as hot-dog sticks and in homicides or suicides. Also, as our case illustrates, toxicities are not limited to temperate climates. (Osterloh *et al*., 1982). The plant is used as a rat poison and an insecticide (Kirtikar and Bassu, 1999). The powdered leaves and bark are used as an insecticide. The toxic component is the two potent cardiac glycosides, oleanderin and neriine, which can be isolated from all parts of the plant both are very similar to the toxin of Foxglove (Shumaik *et al*., 1988). Most symptoms from oleander poisoning are cardiac and gastrointestinal in nature and appear four hours after the ingestion (Behcet *et al*., 2010). A green dye is obtained from the flowers used for various purposes. The plant is commonly used for informal hedging in the Mediterranean. The leaves contain small amounts of latex that can be used to make rubber, though the amount is too small for commercial utilization. The plants have an extensive root system and are often used to stabilize soil in warmer areas. (Sushma and Singh, 1998; Patel, 2010; Rajbhandari *et al*., 2001).

This species also produces secondary metabolites (Paper and Franz, 1989). Preparations of oleander have been used for centuries as folk remedies for indigestion, malaria, leprosy, mental or venereal diseases and as abortifacient (Frohne and Pfander, 1987; Shaw and Pearn, 1997). Furthermore, 80% of the world's population primarily relies on traditional medicines, according to a report by WHOM (Akerlee, 1996). *Susruta Samhita* and *Charaka Samhita* is the core of the Ayurvedic medicinal systems which have describe the therapeutic usage of thousands of plants. One such plant mentioned in Ayurveda is *Nerium odorum* (Singhal and Gupta, 2012). *Nerium odorum* is also used for wastewater purification and for restoration of riparian woodlands (Adrover *et al*., 2008).

In this context this work can add some more important information's regarding *Nerium* in the field of morphology, molecular and tissue culture.

**Plant Classification**
Kingdom: Plantae
Division: Angiosperms
Class: Dicotyledonous
Subclass: Asteridae
Order: Gentianales
Family: Apocyanaceae
Genus: *Nerium*
Species: *odorum*

**Morphological Features**
There are various ways to differentiate the three white, pink and red varieties of *Nerium odorum*, one of the important among them is morphological fertures (Rashmi and Trivedi, 2015).

**Plant**

*Nerium odorum* is an evergreen, perennial, glabrous and erect or decumbent much branched under shrub, often woody towards lower side. It is an erect shrub that grows up to 04-07 meter in height and has cylindrical stems.

**Figure:** Whole plant of *Nerium*

**Root**

Its roots are tuberous with grey cork.The roots of *Nerium* are generally used in medicine that is crooked in shape. Root is prominent, usually branched, 0.5 to 3.9 cm diameter, goes 40 to 95 cm deep into soil. It has tap root system, branched with pale brown colour.

**Figure:** Root of *Nerium odorum*

**Stem**

It is erect, woody, solid, branched, green or grey with latex. Immature green upon maturity they become grey in colour.

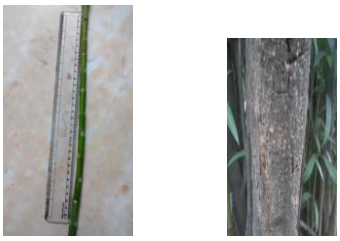

**Figure:** Stem of *Nerium*

**Leaf**

*N. odorum* leaves are simple, lanceolate, 5–23 cm long and 1–3.9 cm broad and with an entire margin, narrow, acute in the apex, shortly petiolate, exstipulated with a coriaceus darkgreen blade narrow, short-stalked and dark or grey-green in colour. Taste of all leaves is bitter. All leaves have a prominent mid rib, are "Leathery" in texture and usually arise in groups of three from the stem, tertiary venation inconspicuous, parallel (unicostate) venation. Epidermis of its leaves are multilayered that is helpful to grow in water stress condition.

**Figure:** All the three leaves of *Nerium odorum*

**Flower**

It is actinomorphic, bracteate, pentamerous, bisexual, complete, hypogynous flower. The plant produces terminal flower heads grow in clusters at the end of each branch, usually pink or white or red, 2.5–6.1 cm diameter with a deeply 5-lobed fringed corolla round the central corolla tube. They are often, but not always, sweet-scented. Each flower has five petalled although some cultivators have double flowers rose like appearance.

**Figure:** Flower of *Nerium odorum*

Calyx- its members are called sepal, these are five in number, gamosepalous, valvate arrangement of green in colour.

Corolla- It is composed of petal, these are five in number, twisted arrangement, gamopetalous, white, pink or red in colour.

Androecium- It is composed of stamen, these are five in number, attached to petal called epipetalous. Filaments are short, dithecous, free (adelphous).

Gynoecium- It is made up of carpel, these are two in number. Ovary is fee but style and stigma are attached (syncarpous). Each ovary has two anatropous ovules and it is superior.

**Fruit**

The fruit consists of a narrow follicle 5–25 cm long which opens to disperse fluffy seeds upon maturity. Oleander can be propagated by seeds but, being allogamous and highly heterozygous. It shows great variability in seedling population.

**Figure:** Fruit of *Nerium odorum* immature

**Molecular Biological Analysis**

Assessment of variations in different cultivars white, pink and red of *Nerium odorum* has been done by using Restriction endinuclease and RAPD PCR (Rashmi and Trivedi, 2013). In this investigation, eight random decamer oligonucleotide primers were used for three *Nerium odorum* cultivars. Out of these eight primers, the amplifications of only three primers were satisfactory and reproducible. The reason for the non-amplifications of the other four primers could not be explained. Probably the sample DNA did not have any binding site for the primers. A similar nonamplification of decamer primers was reported (Hosaka *et al.*, 1994; Cisneros and Quiros, 1995; Sosinski and Douches, 1996; Mattagajasingh *et al*., 2006), in different plant species. In this investigation, RAPD markers were successfully used to differentiate three *Nerium odorum* cultivars from each other which are similar to observations (Rajaseger *et al.*, 1997; 1999). Our results also agree with findings (Loh *et al*., 1999), who used AFLP markers to study genetic diversity in *Caladium bicolar*.

**Micropropagational Studies**

Callus induction from leaf and stem of *N.odorum* as explants has been done (Rashmi and Trivedi, 2014). Rapid *in vitro* culture of this plant from its callus by using different combinations of hormones and their concentrations were established (Rashmi and Trivedi, 2016). Plant cell cultures are a potential source for a huge variety of useful chemical compounds. It is now widely used as a model system to investigate the production of specific secondary products as they offer experimental advantages both to basic and applied research and to the development of models with scaleup potential (Goldstein, 1983; Buitelaar and Tramper, 1992; Chang and Sim, 1995). Untransformed suspension cultures of *N. oleander* L. have been reported (Paper and Franz, 1990; Profumo *et al*., 1993). These cultures need supplementation of exogenous phytohormones both for their growth and secondary metabolites production. A limiting factor against the use of untransformed cultures for synthesis of metabolites at a large scale is that they lose their capacity for producing metabolites after short periods (Mukherjee and Ghosh, 2000). In addition, a rapidly growing and highly productive cell culture system is required for the large scale production of secondary metabolites which could be met only by very few spontaneously high yielding cell culture systems, screened and selected carefully from a heterogeneous cell population. More recently, there have been indications of exploiting crown gall derived suspension cultures as they grow in absence of exogenous phytohormones (Mukherjee and Ghosh, 2000).

**Medicinal Uses**

*Nerium odorum* is used as traditional medicine in different parts of the world, especially in India and China (Dey *et al*., 2012). The Methanolic extract of the plant *Nerium* is used for the treatment of cell proliferation disease in animals and humans (Patel et *al.*, 2010). The leaves and bark are used as heart tonic, diuretic, expectorant, diaphoretic and emetic. (Patel *et al.*, 2010). Its ethno medicinal uses include in the treatment of diverse ailments such as cardiac illnesses, asthma, corns, cancer and epilepsy (Duke *et al*., 1985). A green dye from the flower is used in the treatment of skin diseases and also possesses wound healing and anti inflammatory property. The plant is used in Trinidad and Tobago for reproductive problems (Lans, 2007). Hot water extract of the leaves and seeds are used for upper respiratory tract and gastrointestinal infections in Kenya (Nanyingi *et al.*, 2008). In Calabria, Southern Italy, the plant is used for the treatment of malaria in local folklore medicinal systems (Tagarelli *et al*., 2010). The juice prepared from the stem bark of *N. indicum* is used to cure ear pain in the traditional therapeutic systems in the Kancheepuram district of Tamil Nadu, India (Muthu *et al*., 2006). It is also used as antidiabetic in Morocco (Bnouham *et al*., 2002). In Iloilo, Philippines, the plant is used as ethnomedicine to treat fever, headache, and dermatological problems (Tantiado , 2012). Root past is used in heamorrhods, various type of cancer, Ulceration and leprosy (Vinayagam and Sudha, 2011; Shafi *et al*., 2006; Shashi *et al*., 2013; Shikarwar *et al*., 2009). In the Errachidia province of Morocco, *N. indicum* is used in the treatment of hypertension and diabetes (Tahraoui *et al*., 2007). Oleander extracts have also been used for cardiac insufficiency. This effect was mainly attributed to the cardiac glycosides within all parts of this plant (Langford and Boor, 1996). Among alkaloids some of which are of pharmacological interest, mainly cardenolides, flavonoids and terpenes (Fu *et al*., 2005; Zhao *et al*., 2007). For example, oleandrin has been identified as a potent antitumor compound (Manna *et al*., 2000). Its root is recommended for external application in skin diseases and is a popular remedy for venereal diseases and the oil prepared from the root-bark is recommended for skin diseases also of a scaly nature and for Leprosy.

## 2. Conclusion

From the literature survey concluded that *Nerium* has been used in the treatment of skin diseases, cancer, diabetes, inflammation and CNS depression. So there is need to explore its potential in the field of medicinal and pharmaceutical sciences for novel application. As *Nerium* is a popular remedy among the various ethnic groups, Ayurvedic and traditional practitioners for the treatment of various ailments. So there is need to investigate the therapeutic potential of this plant. Moreover its poisoning aspect must be look into before its use. As these plants are very important in pharmaceutical industries for medicine production. Therefore a care should be taken to make this plant available in large amount by seed, stem cultivation and *in vitro* propagation. Awareness should also be created among farmers to cultivate these plants in their agriculture land.

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