



Nerium oleander Cultivation in Tamil Nadu, India: An Exploratory Study

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

In Indian traditional medicine, *Nerium oleander* is a significant medicinal herb. This plant has the potential to be fatal in many situations; poisoning cases have been documented in tropical and subtropical regions of the world, and suicide cases are common in South Asian nations, particularly in India and Sri Lanka. The plant is hazardous in all sections and contains a range of cardiac glycosides, such as gentiobiosyl, neriin, oleandrin, cardenolides, and odoroside. Additionally, this plant species produces secondary metabolites with medicinal uses, including steroids, flavonoids, and alkaloids. Antibacterial, anthelmintic, anti-inflammatory, hepatoprotective, immunopotential, anti-pyretic, antioxidant, antifungal, anticancer, and anti-HIV activity are among the significant pharmacological activities. *Nerium indicum* is also highly well-liked for its traditional medical applications, which include treating inflammation, wound healing, cancer, asthma, corns, heart disease, and epilepsy. Its bloom is the source of a green dye that is used to cure skin conditions,

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promote wound healing, and have anti-inflammatory properties. Both ultrasonic transesterification and the magnetic stirrer method have been utilized to produce biodiesel from *nerium oleander* oil. When administered topically, *Nerium oleander's* special qualities also have a notable age-defying effect. *Nerium oleander* to acquire several C and N compounds as well as heavy metals that are frequently produced by cars, including as Pb, Cd, Ni, and Zn. Based on the significance of nerium, the study was conducted in the Kanyakumari district of Tamil Nadu, where there is a greater area dedicated to nerium plant cultivation. The study's focus was on the factors that influence nerium cultivation, the factors that contribute to the volatility of nerium prices, and the challenges that farmers face in terms of production and marketing.

Keywords: *Nerium*; medicinal value; biodiesel; poisonous substance; environmental friendly.

1. INTRODUCTION

Nerium (Nerium oleander Linnaeus), one of the dogbanes in the Apocynacea family, is an evergreen shrub or small tree [1,2]. The family Apocynacea belongs to the order Gentianales and has a large and diverse species diversity. According to [3], the family is widely distributed in tropical and temperate regions. Since *Nerium oleander* L. is so extensively grown, its exact origin is unknown, however South West Asia has been proposed. It usually happens near arid creek bed [4]. Although nerium is widely spread in India, only Tamil Nadu is used for commercial cultivation [4]. *Nerium* has erect stems that extend outward as plants age, reaching heights of 2 to 6 meters [4]. The leaves often emerge in groups of three from the stem and are 10 to 22 centimeters long, narrow, sharp, and possess a strong midrib. They have a "leathery" texture. Terminal flower heads are produced by the plant; these are often pink or white, [4]. *Nerium* is an ornamental plant that is utilized in urban landscaping because of its amazing blossoming, which varies in color depending on the type, and its ability to withstand extended droughts [5].

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Neriums are perennial ornamental crops with summer blooms that are members of the Apocyanaceae family. They are mostly found in the arid tropical regions of India. The three *Nerium* species that are commercially relevant are *Nerium indicaum*, *Nerium oleander* var *variegata*, and *Nerium indicaum*. Most of the time, they go by Oleander or Kaner. The shapes and hues of the blooms are what give the *Nerium* cultivars their names. *Nerium* comes in a variety of forms, including dwarf variants like Petite Salmon and Petite Pink and single rose, single white, single red, double rose, double white, double red, double rose, pink, white, and yellow (icar.gov.in).

Propagation and planting: Hardwood or semi-hard woodcuttings of 60 cm in length are used to propagate neriums. An arch is formed when the cut ends are buried in the ground. During the

Table 1. Area, production and productivity for the major flower crops grown in Tamil Nadu

S.No	Flowers	Area (in Ha)	Production (in tones)	Productivity (Tonnes/ha)
1.	Rose	1949	14130	7.25
2.	Jasmine	10623	92951	8.75
3.	Mullai	2769	23537	8.50
4.	Jadhi malli	841	7569	9.00
5.	Crossandra	1317	2634	2.00
6.	Chrysanthimum	2240	20160	9.00
7.	Marigold	1502	22530	15.00
8.	Arali	1195	9261	7.75
9.	Tuberose	1529	15290	10.00
10.	Others	3174	34343	10.82
	Total	25610	227115	8.87

Source: tnhorticulture.tn.gov.in

months of June through July, rooting cuttings are planted in 30 cm by 30 cm by 30 cm trenches that are filled with red earth, FYM, and top soil. Nerium plants are often spaced two meters apart from one another (icar.gov.in).

Soil and climate: In tropical and subtropical climates, it functions well. Soils that are loamy, black, or red lateritic and have sufficient drainage capacity are good for commercial farming (icar.gov.in).

Pruning: In Nerium, pruning is a crucial cross-cultural procedure. Reversing the previous growth's vigorousness is the process of pruning. It is necessary to remove every weak, diseased, crisscross, and unproductive shoot. To stop die back, cover the cut end with copper oxy chloride paste or Bordeaux paste (icar.gov.in).

1st year - Remove one third of the old mature stems near ground level.

2nd year - Remove one half of the remaining old stems and cut back long new shoots.

3rd year - Remove remaining old stems and cut back long new shoots.

Flowering season: Nerium blooms all year round. April to August is when flowers are at their peak (icar.gov.in).

Harvesting and yield: Flowers can be harvested as early as the fourth month following planting. Flower buds that are fully formed and open are picked. Early in the morning and late in the evening is harvest time. One can achieve an approximate flower production of 100–125 kg/ha/day. (*"History - International Oleander Society" 2017*).

Floriculture Research Station, TNAU, Thovalai, Tamil Nadu:

Mandate: Developing and breeding high-yielding flower crop varieties, such as marigold, celosia, chrysanthemum, gomphrena, crossandra, jasmine, tuberose, nerium, and scented rose (<https://agritech.tnau.ac.in/>).

Actions: The list of ongoing subprojects at FRS, Thovalai is provided below.

- HCBE FRS FLO 10 001: Nerium accessions are gathered and assessed for high yield, extended shelf life, and as benchmarks for decorative purposes (<https://agritech.tnau.ac.in/>).

Achievements - Crop improvement: Thus far, 22 accessions have been assembled from various sites, such as the districts of Kanyakumari, Salem, Theni, and Namakkal; Beemanahari, Santhavilai, Thirupathisaram, Aralvaimozhi, Kumarapuram, Thazhakudy, Rasipuram, Salem, and Azhaganapuram; and Kulasekaranpudur. The collected accessions are being evaluated for various yield and growth characteristics as part of the project on the collection and evaluation of Nerium accessions for high yield, prolonged shelf life, and as standards for ornamental purpose. The accs. NI.15 (Red and Pink Mixed Single), assembled from Rasipuram, is clearly showing promise in terms of flower yield based on the data gathered thus far. The trial is now underway. (<https://agritech.tnau.ac.in/>)

Nerium toxicity: Since several of the chemicals in *Nerium oleander* may be harmful when ingested in large quantities, especially by animals, the plant has long been thought to be dangerous. Toxic cardiac glycosides are present throughout the oleander plant. The roots and seeds contain the highest levels. Toxic effects might come from the plant's smoke as well as the water it has been submerged in. These substances include oleandrin and oleandrogenin, also referred to as "cardiac glycosides," which are poisonous when consumed and have a limited therapeutic index [6]. Oral discomfort, nausea, vomiting, cramps, diarrhea, and abdominal pain are signs of oleander poisoning.

Preventive measures: Oleander plant poisoning and reactions show up rapidly, necessitating emergency medical attention in cases of suspected or confirmed poisoning in humans and animals. Atropine and isoproterenol are typically used to treat conduction abnormalities, and activated charcoal may be taken orally. It has been demonstrated that anti-digoxin Fab fragments are a safe and efficient treatment for severe cardiac arrhythmias brought on by yellow oleander [7]. Anti-digoxin antibody therapy can quickly treat hyperkalemia and bradycardia while restoring sinus rhythm. Digoxin-specific Fab's weaker affinity for nondigoxin cardiac glycosides in oleander leads to a higher dose requirement than for digoxin toxicity in general [7].

2. METHODOLOGY

Tamil Nadu's smallest district is Kanniyakumari district. Despite having the lowest area (1672/Sq.Km), Tamil Nadu has the highest

population density (1119/Sq.Km). It is the top in literacy. The District stands apart from the other districts of Tamil Nadu just by virtue of its location. It is the only location on Earth where one can see the sun rise and set simultaneously. Its three sides are covered with a 71.5 km long coastline strip.

The district is located between latitudes 8°03' and 8°35' North and longitudes 77°15' and 77°36' East. The district shares borders with the Thiruvananthapuram District (Kerala) in the west, the Arabian Sea in the west, the Indian Ocean in the south, and the Tirunelveli district in the north and northeast. The Western Ghats mountains border the district of Kanniyakumari on its northern side, while the sea is present on three of its sides. The district's geography is varied.

One of Tamil Nadu's most important districts for the growth of nerium is Kanniyakumari, where the study was conducted for the research.

- **Locale of research:** Kanniyakumari, Tamil Nadu
- **Data collection:** well-structured interview schedule
- **Statistical tools:** Descriptive statistics
- **Sampling:** Selection of the District – Purposive sampling

Selection of blocks – Purposive sampling
 Selection of villages – Random sampling
 Selection of respondents- Snow ball sampling

- **Sample size - 60**



Map 1. Map of Kanyakumari district

Table 2. Factors influenced to cultivate nerium

S.NO	Factors	Frequency	Percentage
1	Suitability of soil	60	100
2	Limited water availability	60	100
3	More returns	38	63.33
4	Less risk	49	81.66

Table 3. Factors involving in nerium price instability

S.No.	Factors	Rank
1	Quality	III
2	Festivals	I
3	Seasonal demand	IV
4	Time of disposing	II
5	Competition among traders	V

Table 4. Constraints in production

S. No	Factors	Rank
1	Scarcity of labour	I
2	Pest and diseases attack	III
3	Harvest during rainy season	II
4	Harvest during cloudy climatic conditions	V
5	Irregular supply of electricity	IV

Table 5. Constraints in marketing

S. No	Factors	Rank
1	Seasonal demand	V
2	Absence of organized retail markets	IX
3	Poor market information	VIII
4	High price fluctuation	II
5	Inadequate transport facilities	X
6	Lack of adequate cold storage facilities	I
7	No proper weighing equipment	IV
8	Price fluctuation	VI
9	Perishable in nature	III
10	Inadequate export facility	XI
11	Irregular payment by the trader	VII

3. RESULTS AND DISCUSSION

3.1 Ethnomedicinal Value

The leaves have been prepared into a decoction and administered externally to cure scabies and reduce edema. Bark is used as a febrifuge, cathartic, and intermittent fever remedy (Valnet, 1976). It is bitter. Leprosy and scaly skin conditions are treated with oil extracted from the root bark. Seeds are used as a purgative for rheumatism and dropsy (Valnet, 1976). Because the root is poisonous, it is only used externally. Despite its power, it may be resolved and is used to treat tumors in the form of plasters. Nerium's leaves and flowers have antibacterial, diaphoretic, cardiotoxic, and diuretic properties. *Nerium* is beaten into a paste with water and applied to lesion and ulcers on the penis (Valnet, 1976). The flowers, leaves, leaf juice or latex, bark, and roots have all been used to cure corns, warts, carcinoma, ulcerating or hard tumors, and the entire plant is thought to have anticancer characteristics (Valnet, 1976). The Federal Drug Administration (FDA) concluded the first phase of oleander extract trials in 2011 and determined that the extract was safe to use in cancer treatment. Additionally, it was discovered that the extract had a favorable effect on malignancies of the bladder, colon, breast, pancreatic, and appendix with very minimal cardiotoxicity or adverse reaction. Patients with advanced cancers have been

treated with Anvirze, an aqueous extract of the *Nerium oleander* plant [8,9]. *Nerium oleander* is also used medicinally to treat ringworm, herpes, abscesses, ulcers, hemorrhoids, and leprosy.

Antioxidant activity: Crude *Nerium oleander* leaves extract had a greater overall level of antioxidant activity (72.8%) compared to the flower (68%) and superoxide radical, whereas the crude floral extract had a higher scavenging activity (66%) compared to the leaves (25%). *Nerium oleander* has strong antioxidant properties, including the ability to scavenge free radicals and reduce their number [10]. The antioxidant activity was shown to be associated with the amount of total phenolic content found in the corresponding extracts used in each assay. *N. Oleander* leaf, stem, and root extracts can be utilized as a natural source of strong antioxidants and work well as free radical scavengers.

Anti-inflammatory activity: Without causing any stomach harm, the ethanolic extracts of fresh and dried *Nerium oleander* flowers demonstrated strong anti-inflammatory effects on mice with carrageenan-induced hind paw edema [6].

Antimicrobial activity: Since medications generated from plants have significantly improved human health, the plant has served as a source of inspiration for new therapeutic molecules. *B. Subtilis* and *Nyctanthesarbortristis* were two bacterial strains on which ethanolic leaf

extract had a notable effect. The antibacterial activity of oleander extracts on gram-negative bacteria was investigated, and it was discovered that these extracts' antibacterial properties were caused by phenolic chemicals, which lower the levels of radicals [6].

Larvicidal activity: According to Kumar et al. [11], the aqueous leaf extract of *Nerium oleander* demonstrated larvicidal and ovicidal qualities. Additionally, the plant's adulticidal and ovicidal effectiveness against *Anopheles stephensi* was documented [12]. Aqueous flower extracts and crude hexane from *Nerium oleander* were used

to investigate the larval mortality of *Culex quinquefasciatus* [13].

Anticancer activity: Ali et al. [14] reported that essential oil could be extracted from oleander blossoms. Cell lines from Ehrlich Ascites Carcinoma (EAC) have demonstrated antitumor activity. After cell cultures were pulse-treated and recovered from, varying amounts of Oleandrin (0.01 ng ml⁻¹ to 50 micrograms ml⁻¹) or Anvirzel (1.0 ng ml⁻¹ to 500 micrograms ml⁻¹) were applied. When Pathak et al. Oleandrin and Anvirzel both caused cell death in human cancer cells, but not in mouse cancer cells.

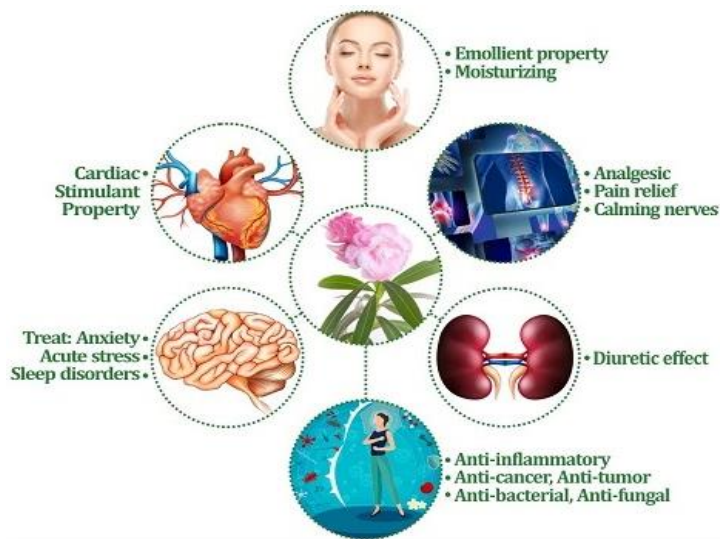


Fig. 1. Biological activities
(<https://www.healthsoul.com/blog/oleander-plant-benefits>)



Fig. 2. Different forms of nerium and uses
(<https://www.healthsoul.com/blog/oleander-plant-benefits>)

Cellular and humoral immune responses: The *Nerium oleander* plant has been found to have very beneficial immune-stimulating qualities by concurrent research. Nerium extracts have been demonstrated through research to particularly stimulate T and B lymphocytes, the humoral and cell-mediated immune systems, as well as the function and capacity of particular subsets of mononuclear cells. *Nerium oleander* significantly modulates the immunological system of rabbits. Rabbits treated with a leaf extract at a dose of 75 mg/kg body weight showed reduced antibody production, inhibition of the delayed hypersensitivity reaction, and phagocytic activity; in contrast, the immune system was stimulated subcutaneously with low doses of 50 and 25 mg/kg body weight [6].

***Nerium oleander* applied science:** *Nerium oleander* (which contains oleandrin and other cardiac glycosides) received oral doses for 46 cancer patients ranging from 0.2 mg to 10.2 mg extract/day [6]. These dosages were given out every day in cycles of twenty-one days to twenty-eight days. PBI-05204 was found to be "well tolerated up to the 10.2 mg extract/day dosage" by the researchers, who also found that there was evidence of tumor response and few serious adverse effects [6]. A *Nerium oleander* extract applied topically does not seem to have any harmful effects. Studies on both humans and animals indicate that using *Nerium oleander* extract topically is safe because these substances are not easily absorbed via the skin [6]. This demonstrates unequivocally that the plant's extracts may be used safely to boost the immunity of the target insects at a lower dosage, in addition to controlling pests. When used topically, the special qualities of *Nerium oleander* also yield a striking anti-aging effect. This discovery led to the development of the Nerium AD skin care line and the founding of Nerium International. To extract the plant's special and beneficial properties while maintaining the plant's original flavor, scientists at Nerium developed a revolutionary technique called NBio-PL2. Nerium's first-ever aged-fying product line is made from the NAE-8 extract, which is a product of a special extraction process and has strong antioxidant properties (Report to Nerium Biotechnology, Inc; 2009).

As per the National Cancer Institute, oleandrin, one of the primary glycosides found in *Nerium oleander*, is "A lipid-soluble cardiac glycoside

with potential antineoplastic activity". The components of AnvirzelTM are active on two distinct cellular pathways to trigger apoptosis and/or autophagy (cell death) in human tumors, but not in normal cells, according to research on cancer conducted at the University of Texas. Additionally, it stops NF-kB from activating, which is a potent signal that encourages tumor cell proliferation and metastasis (Report to Nerium Biotechnology, Inc; 2009).

Traditional uses: Leprosy and alopecia are two persistent and chronic skin ailments for which the leaves were applied externally. The leaves were ground into powder and used as a snuff to treat epilepsy. Root powder mixed with water was administered to treat hemorrhoids and relieve venereal infections [15].

Capslim: This herbal medicine contains Oleander seed powder. This medicine is available in Mexico as a natural anti-obesity treatment [16].

Oleander flower extract: This is a natural remedy, study research has proven its anticonvulsant activity [16].

Biodiesel production from *Nerium oleander* (*Thevetia peruviana*) oil through conventional and ultrasonic irradiation methods: *Nerium oleander* oil has been utilized as a feedstock for biodiesel production through the application of both magnetic stirrer technology and ultrasonic transesterification. For the best results, a two-step transesterification process was used, with the first step being treatment with 0.2% V/V methanol to oil ratio, 1% V/V KOH alkaline catalyst, 55°C temperature, and 60 min reaction time. The second step involved a 0.40% V/V methanol to oil ratio, 1% V/V H₂SO₄ catalyst, and 55°C temperature and reaction time. For roughly ten to fifteen minutes, the procedure is repeated using an ultrasonic approach with an ultrasonic horn type reactor (50 W) at a frequency of 28 kHz. Following that, the percentage yield and physiochemical characteristics of the biodiesel produced using the magnetic stirrer and the ultrasonic technique were contrasted. Improved physiochemical properties and a maximum yield of 97% by weight of oleander biodiesel were obtained by the use of ultrasonic transesterification. Thus, it can be said that the best technique for turning crude oleander oil into biodiesel is the ultrasonic method [17].

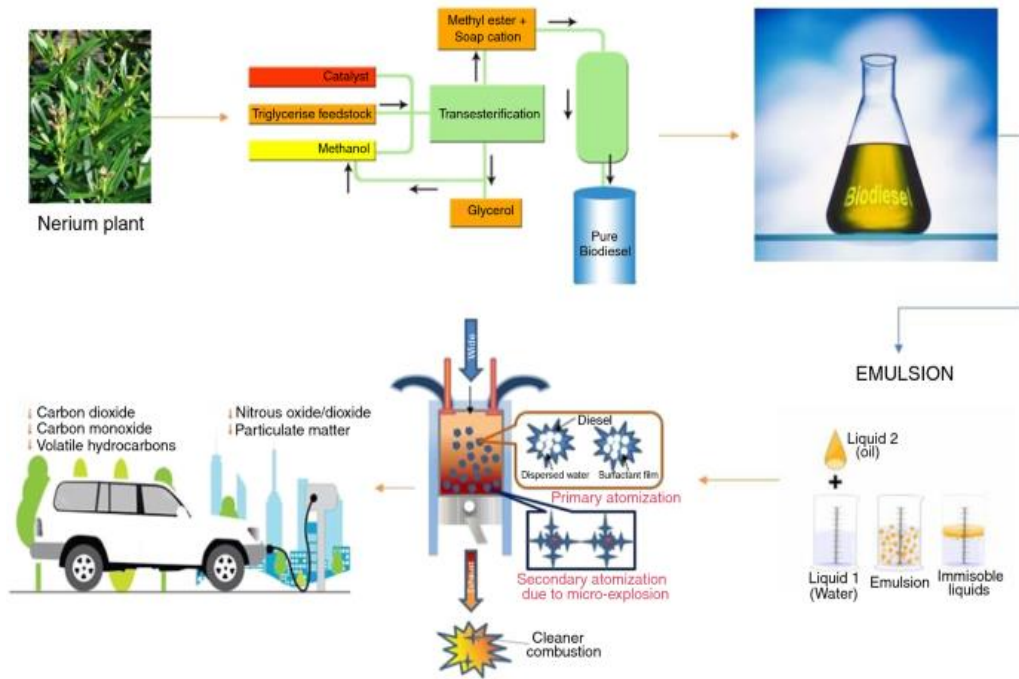


Fig. 3. Biodiesel production from *Nerium oleander*
Ashok et al, [17]

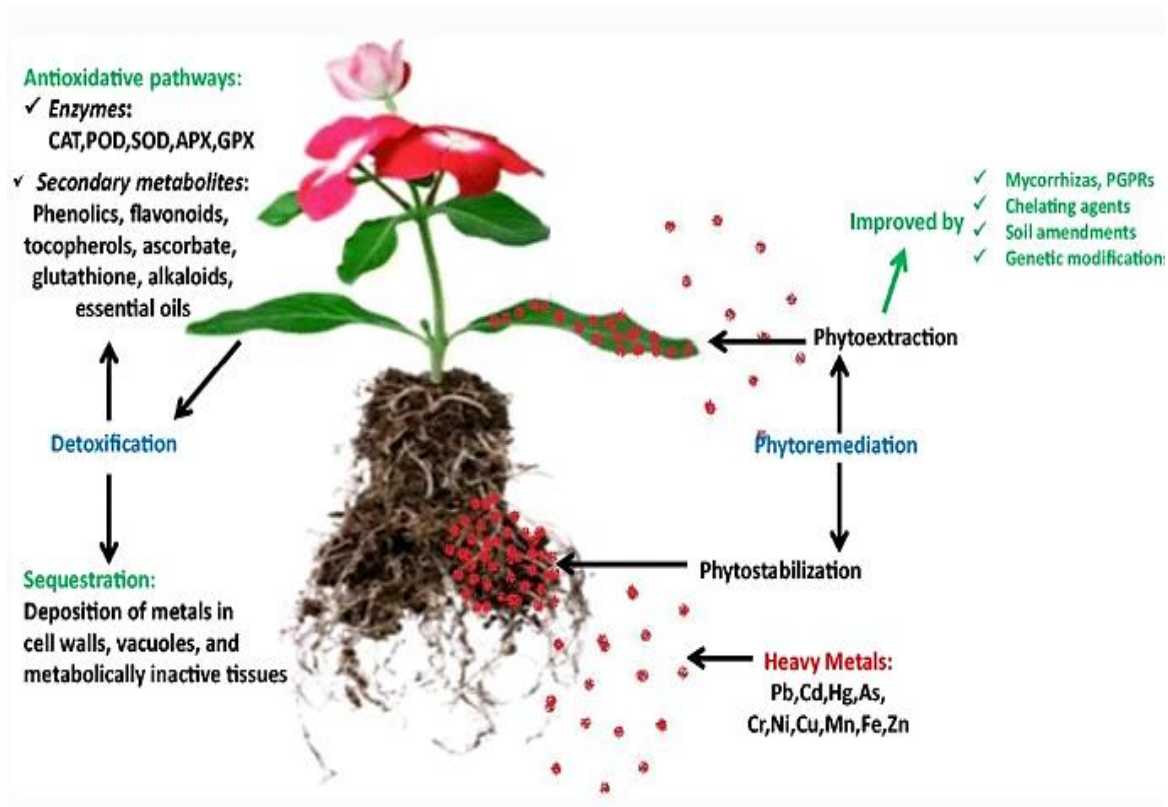


Fig. 4. *Nerium oleander* could be used for sustainable management of traffic-borne elemental-enriched roadside soils

[18]

***Nerium oleander* could be used for sustainable management of traffic-borne elemental-enriched roadside soils:**

Roadside habitats are coated with metal contaminants that are emitted by motor vehicles. Because they are not biodegradable, metals biomagnify in the food chain and pose serious health risks to all trophic levels. Therefore, it is crucial to manage contaminated roadside verges and should be considered when developing particular management plans for these areas. In the most sustainable manner possible, native vegetation may be able to assist clean up soil contaminated by heavy metals. Thus, the purpose of this study was to determine whether *Nerium oleander* can accumulate heavy metals that are frequently released by cars, like Pb, Cd, Ni, and Zn, as well as different C and N compounds, from five different locations along a busy road in Punjab, Pakistan, in the summer and winter [18-21]. The heavy metals Pb and Cd could be absorbed by *N. oleander*; the maximum concentrations of Pb and Cd were 8.991 mg kg⁻¹ and 0.599 mg kg⁻¹, respectively [22-24]. The soluble proteins, free amino acids, gas exchange properties, and photosynthetic pigments were all adversely impacted by these contaminants. However, it was discovered that *N. oleander*'s antioxidant activity was higher in both seasons. However, the summer was when the plant had more metal buildup [25-27]. Our strong recommendation is to cultivate *Nerium oleander* at roadside verges in order to remove automobile pollutants, as this could result in long-term management of these corridors [18].

4. CONCLUSION

Nerium oleander demonstrates anticancer and antitumor characteristics. Ethnobotanical and traditional applications of natural substances, particularly those derived from plants, have drawn a lot of attention lately as they have undergone extensive testing to determine their efficiency and are usually regarded as safe for human usage. *N. oleander* is utilized in Ayurvedic and traditional therapy since it is a well-liked cure across many ethnic groupings. Therefore, more research is required to determine this plant's potential for therapeutic use. Planting more plants will help reduce environmental pollution. *Nerium* is among the greatest choices in places when water is scarce. It is possible to develop technologies for flower plucking. Flowers can be made more durable by adding preservatives before and after harvesting.

The growers proposed a number of strategies to overcome the different challenges, such as concentrating on markets other than the local one, employing chemicals as preservatives for flower preservation after plucking, and lowering labor requirements. In order to do this, more information about the multiple uses for *nerium* is required. By educating growers about these uses, *nerium*'s value can be created, production can be increased, and flower prices can be raised and stabilized.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Chaudhary Kiran, Prasad DN. A review on: *Nerium oleander* Linn. (Kaner). International Journal of Pharmacognosy and Phytochemical Research. 2014;6(3): 593-597.
2. Yadav DP, Bharadwaj NPS, Yedukondalu M, Ravi Kumar A, Phytochemical evaluation of *Nyctanthes arbortristis*, *Nerium oleander* and *Catharanthus roseus*. Indian Journal of Research in Pharmacy and Biotechnology. 2013; 1(3):133-137
3. Barrios B, Koptur S. Floral biology and breeding system of *Angadenia berteroi* (Apocynaceae) why do flowers of the pineland golden Trumpet produce few fruits, Int. J Plant Sci. 2011;172(3):378-385.
4. Parashuram M, KR Rajadurai, S Haripriya. Evaluation of *nerium* cultivars for morphological, flowering and yield traits under Coimbatore conditions. Int J Chem Stud. 2018;6(3):497-501.
5. A. Albornoz M, Fernández J, Vilchez C, Fernández L, Martínez. Effect of paclobutrazol on growth *oleander* (*Nerium oleander* L.) plant in nursery. Revista de la Facultad de Agronomía. 2014; 31:301-311.

6. Saabiya Farooqui, Tulika Tyagi. *Nerium oleander*: It's application in basic and applied science: A review. *Int J Pharm Pharm Sci*. 2018;10(3):1-4.
7. Singh S, Shenoy S, Nehete PN, Yang P, Nehete B, Fontenot D, et al. *Nerium oleander* derived cardiac glycoside oleandrin is a novel inhibitor of HIV infectivity. *Fitoterapia*. 2013;84:32-9.
8. Manna SK, Sah NK, Newman RA, Cisneros A, Aggarwal BB. Oleandrin suppresses activation of nuclear transcription factor-kappaB, activator protein-1, and c-Jun NH2-terminal kinase. *Cancer Res*. 2000;60:3838-47.
9. Pathak S, Multani AS, Narayan S, Kumar V, Newman RA. Anvirzel, an extract of *Nerium oleander*, induces cell death in human but not murine cancer cells. *Anticancer Drugs*. 2000; 11:455-63.
10. Iran MM. Antioxidant activity and total phenolic content of *Nerium oleander* L. grown in North of Iran. *J Pharm Res Autumn*. 2012;11:1121-6.
11. Kumar G, Karthik L, Rao KVB, Kirthi AV, Rahuman AA. Phytochemical composition and mosquito controlling property of *Nerium oleander* leaves (Apocynaceae) against *Culex tritaeniorhynchus* and *Culex gelidus* (Diptera: Culicidae). *Asian Pacific J Trop Biomed* 2012;2:1-6.
12. Roni M, Murugan K, Panneerselvam C, Subramaniam J, Hwang JS. Evaluation of leaf aqueous extract and synthesized silver nanoparticles using *Nerium oleander* against *Anopheles stephensi* (Diptera: Culicidae). *Parasitol Res*. 2013;112: 981-90.
13. Raveen R, Kamakshi KT, Deepa M, Arivoli S, Tennyson S. Larvicidal activity of *Nerium oleander* L. (Apocynaceae) flower extracts against *Culex quinquefasciatus* Say (Diptera: Culicidae). *Int J Mosquito Res*. 2014;1:38-42.
14. Ali HFM, El-Ella FMA, Nasr NF. Screening of chemical analysis, antioxidant antimicrobial and antitumor activities of essential oil of oleander (*Nerium oleander*) flower. *Int J Biol Chem*. 2009;4:190-02
15. Khare CP. *Encyclopedia of Indian medicinal plants*, Springer-Verlag-Heidelberg. 2004;328-330.
16. Garima Zibbu, Amla Batra. A Review on Chemistry and Pharmacological activity of *Nerium oleander* L. *J. Chem. Pharm. Res*. 2010;2(6):351-358.
17. Ashok Kumar, Yadav, Mohd. Emran Khan, Jamia Millia Islamia, Amit Pal. *Korean Journal of Chemical Engineering*. 2016;34(2):34(2). DOI:10.1007/s11814-016-0270-8
18. Noreen Khalid, Ali Noman, Atia Nazir, Aasma Tufail, Naila Hadayat, Fahad Mohammed Alzuaibr, Sobia Ikram, Noreen Akhter, Mumtaz Hussain, Muhammad Aqeel. *Environ Sci Pollut Res Int*. 2023, Mar;30(14):40551-40562. DOI: 10.1007/s11356-023-25160-z. Epub 2023
19. Dey Priyanka, Chaudhuri Tapas Kumar. *Pharmacological aspects of Nerium indicum* Mill: A comprehensive review. *J. Pharmacognosy Review*. 2014;8(16): 156-162.
20. Gayathri V, Ananthi S, Chandronitha C, et al. Cardioprotective effect of *Nerium oleander* flower against isoproterenol-induced myocardial oxidative stress in experimental rats. *J Cardiovasc Pharmacol Ther*. 2011;16(1):96-104.
21. History - International Oleander Society; 2017. Available: https://agritech.tnau.ac.in/about_us/abt_us_research_thovalai.html
22. KG Singhal, GD Gupta. Some central nervous system activities of *Nerium Oleander* Linn (Kaner) flower extract. *Tropical Journal of Pharmaceutical Research*. 2011; August;10(4):455-461.
23. Mary SJ, Chithra B, Sivajiganesan S. *In vitro* anti-inflammatory activity of the flowers of *Nerium oleander* (white). *Intern J of Res- Granthaalayah*. 2017;5(6):123-128.
24. Phytochemical and pharmacological potential of *nerium oleander*: A review. *international journal of pharmaceutical sciences and research*.
25. STT. *Research Int*. An open-label, non-randomized, pilot study to test the safety and efficacy of Nerium-AS, a topical natural Nerium-based solution, (the Test Article) in patients with solar lentigines (Age Spots) and actinic keratosis. Report to Nerium Biotechnology, Inc; 2008.
26. ST T. *Research Int*. Pharmacological effects of single and multiple dose topical administration of Nerium LS-A and Nerium

- LS-HW in New Zealand White Rabbits. Report to Nerium Biotechnology, Inc; 2009.
27. Tasleem Akhtar, Nadeem Sheikh, Muddasir Hassan Abbasi. Clinical and pathological features of *Nerium oleander* extract toxicosis in wistar rats. BMC Research Notes. 2014;7. Article number: 947.

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