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REVIEW PAPER

Assessing the role, position and challenges facing the development of planting *Conocarpus erectus* L. in order to improve the environmental conditions affected by pollutants and dust (Case study on Ahvaz city)

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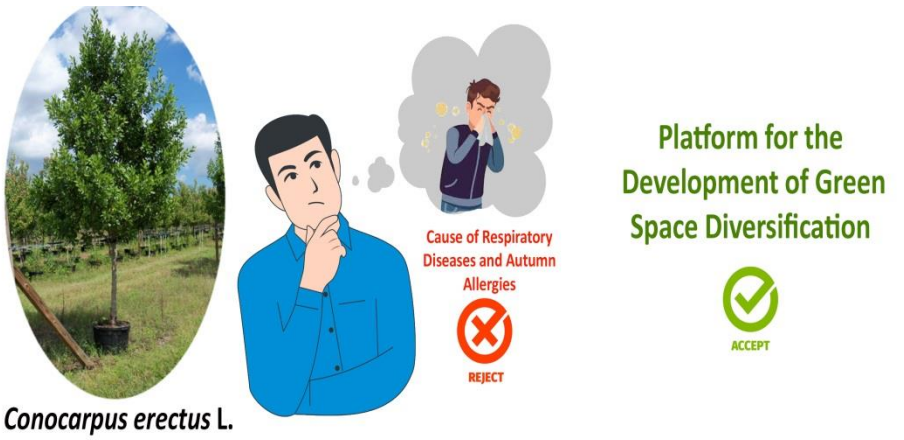
Highlights

- The most challenges facing the development of planting Conocarpus erectus in order to improve the environmental conditions (pollutants and dust) in Ahvaz city assessed.
- Some problems in planting for the municipal sewage network and also risks for electricity supply network must be considered.
- Finally the planting of Conocarpus erectus can improve the environmental conditions affected by pollutants and dust for some physiological and tissue structure.

Graphical Abstract



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Abstract

Conocarpus erectus L, which occupies more than 60% of the green space of Ahvaz, has been faced with baseless and populist accusations such as non-use for nesting birds, and non-use for its gum and various parts by insects and other animals. Also, it has become a dangerous threat by identifying this plant as the cause of respiratory diseases and autumn allergies in the city of Ahvaz and the southern parts of Khuzestan province. On the other hand, some people believe this plant, with its fast-growing characteristics, is a profitable and investment-friendly species for seedlings, and these are perhaps the simplest general views of the Conocarpus tree in Iran. The results of scientific research indicate that the presence of this plant in the green spaces of Khuzestan province and Ahvaz city can have many beneficial effects for the region and can also be a platform for the development of green space diversification. Perhaps one of the biggest problems of this plant is its allergenic nature. According to the researches, not only this plant is not allergenic, but also due to frequent pruning, it grows only in the vegetative phase and does not enter the reproductive phase. However, the incorrect location of this plant in some urban areas due to the lack of proper infrastructure makes problems for the faulty municipal sewage network and also poses a risk to the electricity supply network that must be considered. In this article, by considering scientific sources and materials, the role, position and challenges facing the development of planting this plant, regardless of public and populist views, have been discussed in order to improve the environmental conditions affected by pollutants and dust.

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1. Introduction

Conocarpus erectus L, a member of the Combretaceae family, is one of the most famous marine trees in the United States, the coast of Mexico, and parts of West Africa (Salimi et al., 2021). It is an evergreen tree with a height of 4-20 meters and a wide crown, the diameter of the trunk of this tree reaches 20 cm; Gray to brown bark, uneven and grooved, which due to its rapid growth and easy reproduction has been able to increase the per capita green space of southern cities and is very useful for the region (Ochoa-Gómez et al., 2021). It is an evergreen tree that is usually planted in tropical and saline soils. Its planting areas do not require drainage and organic minerals and have good resistance to harsh environments (do Nascimento Santos et al., 2021). It is planted as a tree resistant to salinity and heat as well as water shortage to protect beaches and saline lands. Due to its high resistance to saline soils, it is well planted in areas near the sea and also in cities along sidewalks, squares and midfield of streets. Due to its good shade, its planting program in the hot cities of the country is being pursued by municipalities and its related organizations (Khadhim and Kadhim, 2021). Its planting program continues in the countries of the Persian Gulf, as well as Saudi Arabia, Iraq and Iran, which have hot and dry areas and usually with saline soil (Boloorani et al., 2021). It gives a beautiful view to the cities. Among the provinces where this tree is planted in Iran, we can mention Khuzestan, Bushehr and Hormozgan. This plant grows in coastal areas but can also be found in coastal and arid areas. In addition to Iran, it is also found on the coasts of California, Florida, hot and humid America, and Brazil (Chehrazi et al., 2021).

2. Botany

Conocarpus is an ornamental plant common in tropical and semi-tropical regions, usually seen as a shrub 1.5 to 4 meters high; Of course, sometimes it can grow as a tree or even up to 20 meters in height (Fig. 1). Due to resistance and adaptation to hot and dry air, dry soil, poor drainage, air pollution and dense soils, have become very important in the past decades in the country, especially in Khuzestan. The very rapid growth of this shrub is another important factor that has played a role in its potential (Rad et al., 2019). Alternate leaves, short petiole, the leaves are usually over 4 cm long and 1 to 2 cm wide, the flowers are pale with white flower clusters, the flowers are bisexual. They bear fruit throughout the year (Fig. 1). The fruit of this tree is reddish-brown (Tauqeer et al., 2019). These shrubs are widely planted as ornamental plants along the streets. The extract of its leaves has been used to treat bleeding gums, colic and skin wounds. According to the trait of the species (Erectus), its leaves and crown are erect. This plant is not shade tolerant and will not grow in the shade of larger trees (Fig. 1). The most important part of this plant is its leaves. Leaves in different cultivars are broad or narrow, large or small, green or silver. The methods of propagation are transplanting, branch planting, and leafing the leaves. The most successful way of propagation is planting seeds in pots and containers (Hussain et al., 2017). This tree is planted in three provinces of Iran; Khuzestan, Bushehr, and Bandar Abbas (Amiri et al., 2019). Two different types of Conocarpus are known (Safwat et al., 2018):

a) Green Conocarpus with scientific name (*Conocarpus erectus* var. Erectus): The leaves are either hairless or have sparse hairs on them.

b) Silver Conocarpus with scientific name (*Conocarpus erectus* var. Sericeus): Dense silver hairs can be seen on the leaves of this variety.

Fig. 1. Conocarpus tree, leaves and flowers (Safwat et al., 2018).

3. Phytoremediation mechanism of plant

Researchers at Shahid Chamran University concluded that the tree cleared the soil well to a concentration of 50,000 mg/kg. The results of the experiments show that according to the value of air pollution resistance index obtained between 17 and 29, it can be concluded that the Conocarpus tree has a relative resistance to air pollution and due to its stickiness on the leaves, the plant can Absorb pollution and allow citizens to breathe less air pollution (Seyyednejad et al., 2017). Therefore, it helps to absorb contaminants. The researchers also stated that Conocarpus is one of the major plants for the elimination of air pollution, especially heavy metals (molybdenum, cadmium, mercury, lead and iron) and has been introduced as a bio-detector of air and soil pollution; This plant can be named as one of the medicinal plants used in general medicine for many diseases that four types of methanol are obtained from extracts of Conocarpus various parts (bark, branches, leaves, flowers and fruits) (Hussain et al., 2017; Rehman et al., 2019). Considering the presence of all studied heavy metals in the dust coming to Ahvaz city and the existence of a direct relationship between the concentration of metals in soil and tree leaf samples and their concentration in dust samples, it can be probable that dust is one of the factors that has been involved in the concentration of heavy metals in the studied species. On the other hand, by comparing the concentration of heavy metals in the leaves of trees, it is inferred that each of them has more potential in absorbing certain heavy metals, but in a general comparison, considering the concentration of all metals in the leaves of species showed that the potential of the studied plant species in the absorption of heavy metals in the Conocarpus tree is at a high level (Ashraf et al., 2018; Tauqeer et al., 2019; Azadbakht et al., 2020; Zargaran Khouzani and Gharineh, 2021).

4. Other features and capabilities

Conocarpus tree has very high capabilities such as resistance to saline soils, wetland, drought, and air purification. Despite these properties, Conocarpus wood has a high chlorophyll content for fuel, charcoal production, and other industrial and pharmaceutical uses; Conocarpus is one of the most developed plants in Saudi Arabia, UAE, Pakistan and Kuwait and is used in a number of countries as a medicinal plant. Traditional medicine claimed that it can be used against colds, high fever, diabetes, etc. In Africa, the tree is used as a green fodder in ruminant diets. Some reports suggest that Conocarpus foliage is palatable and an attractive plant for animal feed with a protein content of 7 to 11% (Bashir et al., 2015; Baroon and Razzaque, 2013). Conocarpus is also recommended as a food and wildlife sanctuary, soil protection and sand stabilizer, and as a major source for smoking fish and meat; Conocarpus bark extract is also used for medicinal purposes such as stopping blood and menstruation, stomachache and healing wounds and sores (Amiri et al., 2019; Ashraf et al., 2018; do Nascimento Santos et al., 2021). According to facial research by Khademi Hamidi et al., (2019), the use of Conocarpus extract in the diet of rainbow trout led to improved growth, digestive enzymes and nonspecific immunity of blood (Khademi Hamedi et al., 2019).

5. Allergy and Conocarpus

No disease caused by Conocarpus has been reported. Also, the results of studies conducted show that Conocarpus, due to its wide leaves, has a high ability to absorb fine dust and causes these fine dust, which have fungal spores, less enter the lungs of citizens (Das et al., 2020). Regarding the allergenicity of pollens, like many other plants that cause allergies in spring and autumn, it should be said that the pollens of this plant do not come out of the pollen sac and are relatively large and heavy and do not scatter in the air like other trees (Rad et al., 2019). On the other hand, most Conocarpus trees are always in the growing stage because they are regularly pruned and do not reach to reproductive stage, and there is less place to reach the flowering and pollination stage, this pollination is not so much that it can cause problems due to rain. That 20% that have not been pruned can be effective in the city (Namjoyan et al., 2020). The antigen technique was used and it was stated that if pollen is allergenic, it should be diagnosed first by some techniques. Many more techniques have now entered medical science, but none of these techniques have been used in researches (Al-Dowaisan et al., 2004). Also,

research has not mentioned the amount of pollen produced by Conocarpus. For example, a pecan tree produces 30 million pollens, but how many pollens does a Conocarpus tree produce? At present, it is easy to detect that pollens are scattered up to a few meters, but we do not have exact information available. Six years have passed since the respiratory crisis following the autumn rains (Al-Dowaisan et al., 2004). If we follow this process, the question arises for the people, what is the scientific community of Khuzestan province doing? There are technologies now and we do no longer need to work in the laboratory. In one European study, pollen studies were performed by satellite. There have been no reports of Conocarpus pathogenesis. We do not know how the compounds in Conocarpus seeds react with other factors. According to all reports, near the rainy season, the rate of pollen dispersion is high; however, the allergenicity of Conocarpus pollen has not been proven yet (Namjoyan et al., 2020; Rad et al., 2019).

6. Contrast with infrastructure

Researchers recommend that do not grow this tree near residential areas and buildings due to its high water consumption and lateral damage of its roots to water plants. Many citizens, without knowing the type of this tree, planted it in front of their homes and sidewalks, but the roots of this tree have damaged infrastructure facilities such as sewerage networks, water pipes, municipal gas pipelines, underground water canals, and the power distribution network (Fig. 2) (Shamukh et al., 2020). In the city of Ahvaz, first, these trees were predicted for planting in the green belt of Ahvaz and outside the urban environment, but with an unprofessional action and entering the urban space, its long-term harms were ignored. Although this tree has an effective role in increasing the green space per capita, due to problems in infrastructure, it should be planted in a limited and controlled way in urban areas (Deister, 2013; Chehrazi et al., 2021) presented a solution to solve this problem, because of the Conocarpus roots go down vertically, first, the ground should be dug to a depth of 60 cm and then this tree should be planted so its roots do not penetrate the surface of the passageways. According to experts, this plant, due to its rapid growth and excessive use of nutrients, impoverishes the soil and prevents sunlight from spreading to other plants with high shade. From the point of view of urban design and arrangement of green space, this tree also makes problems because due to the foliage that grows from the bottom of the tree, it reduces the angle of view on boulevards and streets and it can cause an accident, so it is dangerous (Chehrazi et al., 2021; Kashefi et al., 2014).

Fig. 2. Pruning and shaping of Conocarpus in urban areas (Kashefi et al., 2014).

The roots of this tree, in addition to severe and unprecedented destruction of urban infrastructure, have caused the most severe damage to the facilities of Water and Sewerage Company including severe destruction of water pipes and then the entry and blockage of the network of water facilities, severe destruction of tanks and pumping stations Water, severe pollution of drinking water due to mixing with city gas and sewage,

infiltration into the sewerage network through the smallest pores and obstruction due to widespread diffusion of roots, unparalleled destruction of domestic sewer pipes and infiltration in the upper floors, infiltration of slates And pumping stations and causing damage to sewage facilities, causing severe corrosion in concrete pipes and destroying them (Shamukh et al., 2020). According to the official announcement of the senior managers of Water and Sewerage Company, the Ahwaz sewerage network has been extensively damaged and destroyed, and more than 1,200 sewage clogging and rising points in the Ahwaz metropolis have created a dire situation for the oppressed people and citizens of the province. Studies show that by 2021, Ahvaz will face 2,000 points of 100% sewage blockage and according to the 2,500 kilometers length of the network and the 350,000 cubic meters daily production of sewage, the occurrence of such a thing will be a great disaster (Rad et al., 2019; Boloorani et al., 2021; Zeidali et al., 2021).

7. Conclusion

Despite the claims of domestic and foreign researchers that Conocarpus pollen is not considered allergenic and they believe that these trees are pruned frequently in Ahvaz and do not reach the stage of seeding and pollination that can be the main cause of allergies among citizens. Like any other phenomenon in Iran, proponents and opponents do not accept each other's opinions. Those who do not blame Conocarpus for allergies believe that the tree has been unloved by environmentalists and contrary to rumors, Conocarpus trees that are not pruned are also nested by birds, and pruning them causes birds to flee and even bees visit Conocarpus trees, but pruning prevents them to make a hive on them. The biggest challenge for Conocarpus is the accusation of urban infrastructure destruction and allergenicity, which were discussed in this article. Now, in your opinion, if the urban infrastructure (including water and sewage network) were principled and also the polluting factories were located outside the city, would these problems affect Conocarpus and the citizens of Ahvaz? Why are these problems not reported in the home of this plant in the United States or neighboring countries like Saudi Arabia, UAE, Kuwait and even Pakistan? In your opinion, is Conocarpus the main cause of disturbing the health and well-being of Ahwazi citizens? It seems that until more detailed studies are done on this species, one side of this controversy cannot be accepted with certainty, but there is no doubt that besides the Corona crisis, other respiratory crises threaten the Ahvazi citizens.

In addition to conducting extensive research on the status and importance of this plant in the city of Ahvaz and Khuzestan province, it is recommended to all researchers and experts to identify diverse plant species that are compatible with the current green space and urban infrastructure to be able to achieve a diverse green space cover and a combination of fruitful and non-fruitful plants, during next years.

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