GRADIVA

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

A Review on General Description of *Leucaena Leucocephala* (Lam.) De Wit

Amira KORTI[1]*, Djilani GHEMAM Amara[2],
Ahmed Elkhalifa CHEMSA[3] & Noura GHERAISSA[4]

[1,2,3,4]Department of Biology, Faculty of Natural Science and Life, El Oued University, El Oued, Algeria.
[1,2]Laboratory of Biology, Environment and Health, El Oued University, El Oued, Algeria.
[3,4]Laboratory of Biodiversity and Application of Biotechnology in Agriculture,
El Oued University, El Oued, Algeria.
*Corresponding Author Email: amira-korti@univ-eloued.dz

Abstract

Leucaena leucocephala (Lam.) de Wit is a fast-growing, nitrogen-fixing leguminous tree native to Central America and widely recognized for its ecological resilience and multifaceted utility. It has been extensively introduced across tropical and subtropical regions for purposes including agroforestry, soil improvement, livestock fodder, fuel wood, and environmental restoration. This review provides a comprehensive overview of the species, highlighting its taxonomic classification, morphological features, ecological requirements, and traditional uses. Particular emphasis is placed on its reproductive strategies, phenology, and effective seed dispersal mechanisms that contribute to both its beneficial spread and invasive behavior. While *L. leucocephala* plays a critical role in sustainable land management and local economies, its aggressive growth, allelopathic potential, and displacement of native flora have raised significant ecological concerns. The dual nature of this species underscores the importance of balanced management approaches that maximize its advantages while mitigating its environmental risks. This paper aims to inform researchers, land managers, and policymakers about the ecological and agricultural significance of *L. leucocephala* and the challenges associated with its widespread use.

Keywords: *Leucaena Leucocephala; Nitrogen Fixation; Invasive Species; Drought Tolerance; Morphological Traits; Ecological Impact.*

INTRODUCTION

In the context of global climate change, soil degradation, and the search for sustainable agricultural practices, leguminous trees have garnered significant attention for their ecosystem services and economic value. Among these, *Leucaena leucocephala (Lam.) de Wit* stands out as a fast-growing, nitrogen-fixing legume with exceptional adaptability to a wide range of environmental conditions (Bageel, Honda, Carrillo, & Borthakur, 2020; Shelton & Brewbaker, 1994). Originally native to Central America and Mexico, this species is now naturalized in more than 130 countries, particularly in tropical and subtropical regions around the world, owing to its role in agroforestry, animal feed production, land rehabilitation, and biomass energy (Bakewell-Stone, 2023; Buck, Rolfe, Lemin, & English, 2019; de Sousa Machado, Drummond, & Barreto, 2020; Lim, 2011; Whitesell & Parrotta, 2008) .

Unlike many cultivated species, *L. leucocephala* displays a unique capacity to thrive in marginal soils, resist drought, and regenerate rapidly after harvesting. Its root symbiosis with rhizobia enhances soil nitrogen levels, while its deep root system allows it to stabilize degraded landscapes (Honda, 2021; Pandey & Kumar, 2013). These traits have made it a key player in integrated farming systems, especially in arid and semi-arid zones where conventional crops

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

often fail. Its use as green manure, shade for plantation crops, and windbreaks further supports its reputation as a "miracle tree" in sustainable agriculture (De Angelis, Gasco, Parisi, & Danieli, 2021; Steppler & Nair, 1987).

However, the same traits that underpin its utility also contribute to its invasiveness. Classified among the world's 100 worst invasive species due to its aggressive spread, allelopathic behavior, and ecological disruption. (Kato-Noguchi & Kurniadie, 2022), *L. leucocephala* aggressively colonizes disturbed habitats, displacing native flora and altering ecosystem dynamics. Its allelopathic potential, long seed viability, and rapid vegetative propagation enhance its ability to spread beyond intended boundaries (Chiou, Wang, Chen, Grant, & Lu, 2013; Marques, Costa, Atman, & Garcia, 2014).

Given this paradox of being both an ecological asset and a biological threat it is imperative to synthesize current knowledge surrounding *L. leucocephala*. This review aims to critically examine its taxonomy, physiological traits, ecological adaptability, geographical spread, traditional and industrial uses, and invasive potential. By integrating multidisciplinary insights, the paper seeks to inform future research and guide policies for responsible utilization of this globally significant species.

Synonyms and Common Names

Leucaena leucocephala (Lam.) de Wit has been ascribed various names in the past, including *Mimosa glauca* sensu L. (1763), *Mimosa leucocephala* Lamark (1783), *Acacia leucocephala* (Lamark) Link (1822), and *Leucaena glabrata* Rose (1897**) (Godefroy, 1987; MacLaurin, Tainton, & Bransby, 1981; Pandey & Kumar, 2013)**. Additionally, this plant has many common names around the world, which reflects its varied uses and local significance. While it is known as lamtoro or petai belalang in Indonesia (Kuppusamy, Arumugam, Azaman, & Jen Wai, 2014; Steppler & Nair, 1987). It is called subabul in India (Sethi & Kulkarni, 1995). In the Philippines, it is commonly referred as giant ipil-ipil and in Thailand, it is called Krathin ban (Burawat, Uabandit, Sripanidkulchai, Nualkaew, & Iamsaard, 2016; Steppler & Nair, 1987). In Hawaii, it is known as koa haole, because it resembles the native Acacia koa (Idol, 2019; Takahashi & Ripperton, 1949). Also it is known by several names in English-speaking regions, including horse tamarind, wild tamarind, and white lead-tree (MacLaurin et al., 1981; Raman, Rana, & Sarma, 2018) . Other names include stuipboom in South Africa, faux-acacia in French-speaking areas, and cowbush in the Bahamas (C. Walton, 2003). Demonstrating its pervasiveness and significance across a range of global ecosystems and cultures (Hughes, 1998).

Taxonomic description

The genus *Leucaena* Benth., belonging to the Fabaceae family and classified under the tribe Mimoseae, shares a close evolutionary relationship with genera such as Acacia, Mimosa, and Desmanthus (Ishak, Iberahim, & Mardiana-Jansar, 2021; Nehdi, Sbihi, Tan, & Al-Resayes, 2014; Takahashi & Ripperton, 1949). The name *Leucaena* originates from the Greek terms "leuc" and "caen," alluding to the pale hue of its blossoms (Raman et al., 2018). In addition to its botanical importance, *Leucaena* is a species of great ecological and agricultural importance due to its high nutritional content (Raman et al., 2018). It comprises 22 species, along with 4 subspecies, 2 varieties, and 2 hybrid forms (de Sousa Machado et al., 2020). Taxonomically, it is part of the family Leguminosae, within the subfamily Mimosoideae and the tribe Mimoseae. placed it within the order Mimosae, tribe Eumimosae (de Sousa Machado et al., 2020; Kuppusamy et al., 2014; Lenné, 1991). Of the nine primary species, *Leucaena leucocephala*

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

(Lam.) de Wit, described in 1961, stands out as the most economically valuable, known for its wide range of ecological and agricultural applications.

Originating mainly from tropical regions of the Americas and the Pacific islands, members of this genus typically present as small to medium-sized trees, displaying traits characteristic of the Mimosoideae subfamily. These trees contribute significantly to various ecosystems (Harris, Hughes, Ingram, & Abbott, 1994; Ishihara, Honda, Bageel, & Borthakur, 2018; Takahashi & Ripperton, 1949; C. Walton, 2003). There are three recognized subspecies of *Leucaena leucocephala*: *Leucaena leucocephala* subsp. *Glabrata (Gaint leucaena)*. When; *Giant leucaena* can be classified into two distinct types: the Salvador type, which has few branches, and the Peru type, known for its low branching habit. *Leucaena leucocephala* *subsp. leucocephala:* The most widely naturalized type, often considered more invasive and *Leucaena leucocephala* subsp. *Ixtahuacana is Less commonly cultivated, with restricted distribution and ecological specificity (Honda, 2021; Lok, Tan, Ang, & Tan, 2010)*. It has also been identified as a shade-intolerant species, requiring high levels of light for successful growth and establishment (Marod et al., 2012).

Morphological description

Leucaena leucocephala is a tiny tree or shrub that is erect, perennial, and thornless(Shelton & Brewbaker, 1994; C. Walton, 2003) . Usually growing on steep hillsides, it can reach a height of 7 to 18 meters (rarely 20 meters) if it receives enough sunlight. and is a fast-growing tree with a trunk that is 5 to 50 cm in diameter (Lim, 2011; C. S. Walton, 2003). While the most common form is a long-lived, free-seeding shrub. It can grow into a larger tree with a well-developed canopy, exhibiting adaptability to different settings while maintaining its unique thornlessness (Chiou et al., 2013; de Sousa Machado et al., 2020; Zarina, Ruzaidi, Sam, Bakri, & Aminah, 2018). The bipinnate leaves, which are made up of many tiny, oval-shaped leaflets, are placed alternately along the stem. The leaves range from light to dark green color (Nehdi et al., 2014; C. S. Walton, 2003).

Folding up under dry conditions, leaves exhibit xerophytic mobility and may quickly wither when removed from branches (MacLaurin et al., 1981). The petiole, 4-9 pairs of pinnae and 13-21 pairs of leaflets per pinna(Lim, 2011). This species can prematurely shed its leaflets in response to environmental stress since it is facultatively deciduous (C. Walton, 2003). In contrast, the leaflets are small, ranging in length from 9 to 21 mm and width from 2 to 4.5 mm, and contain a concave, cup-shaped, elliptic petiole gland known as extrafloral nectaries (Bakewell-Stone, 2023; Lim, 2011).

They are rounded to obtuse at the base, linear-oblong to weakly elliptic, glabrous except for the edges, and sharp at the tip (Bakewell-Stone, 2023). While the upper surfaces are lustrous and green, the lower surfaces are grey-green (MacLaurin et al., 1981). A flower head, measuring 12–21 mm in diameter, actively grows young shoots and bears 100–180 cream-white flowers. Each flower has ten free stamens with hairy anthers and is borne on 2–3 cm long stalks at the ends or sides of twigs (Lim, 2011; Sharma, Kaur, Batish, Kaur, & Chauhan, 2022; Takahashi & Ripperton, 1949). Flowers are white and mainly autogamous (MacLaurin et al., 1981) . Flowers typically appear on newly growing shoots, where leaf formation occurs concurrently (Kato-Noguchi & Kurniadie, 2022). It produces 5 to 25 flat pods, which range in shape from linear to oblong and have a lustrous surface covered in velvety hairs (Bakewell-Stone, 2023; Kato-Noguchi & Kurniadie, 2022; Sharma et al., 2022).

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

Generally, It is common to find flowers alongside both immature and mature pods coexisting on the tree simultaneously (Nehdi et al., 2014). The pods measure 10 to 20 cm in length and 5 to 10 mm in width, containing 10 to 30 smooth, are oval, flattish, seeds that are dark brown in color and approximately 6 × 4 mm in size, 4–6.3 mm wide and 6.7–9.6 mm long. The medium sized seeds weigh 15 000–20 000 seeds/kg (ORWA, MUTUA, KINDT, JAMNADASS, & SIMONS, 2009; Pandey & Kumar, 2013). Upon maturity, the seeds are released from both margins of the pod. The pods can be yellow, green, or brown in color and are generally flat and fairly straight (Lim, 2011).

Leucaena leucocephala is a spineless, evergreen leguminous tree distinguished by its robust trunk, which divides into several large branches. In open habitats, it typically forms a broad, umbrella-shaped crown (MacLaurin et al., 1981; Orwa, 2009). The bark on young branches is typically mid grey-brown with narrow, rusty orange-brown vertical fissures. In contrast, older branches and the main stem develop a rougher texture and a darker grey-brown coloration, with a conspicuously deep red inner bark (Bakewell-Stone, 2023; C. S. Walton, 2003). Furthermore, it establishes vesicular-arbuscular mycorrhizal associations with the roots, which may enhance its ability to absorb phosphate more efficiently. The stem is woody, cylindrical, erect, branched and solid, with rough, shallow, rusty orange-brown vertical fissures. Branches are smooth, stout, and dark grey-brown.

Stems can grow rapidly, reaching heights of 2 to 20 m if left unchecked, with trunks measuring 10 to 37 cm in diameter (MacLaurin et al., 1981; Pandey & Kumar, 2013; Sharma et al., 2022). While, the root system of mature plants is deep and well-developed, consisting of a long taproot, numerous robust lateral roots, and many fine tertiary roots (Sharma et al., 2022). Main roots are capable of reaching depths of three to five meters, enabling them to penetrate compact soil layers and break up and aerate impervious soils. Because it has deep, penetrating roots, the plant is drought tolerant. Small lateral roots, bearing the nitrogen-fixing nodules, occur near the soil surface (MacLaurin et al., 1981; Takahashi & Ripperton, 1949).

Geographical distribution and habitat

The leguminous tree *Leucaena leucocephala* is originally indigenous to Mexico and northern Central America, with its natural range extending through areas such as Jalisco, Michoacán, Chiapas, and the Yucatán (Awe, Giwa-Ajeniya, Akinyemi, & Ezeri, 2013; Dijkman, 1950; Hajar & Mukassabi, 2016) Its remarkable adaptability and fast growth rate have facilitated its introduction and naturalization across a wide spectrum of tropical and subtropical environments globally (Lim, 2011; Soedarjo & Borthakur, 1996).

It is now present across the Caribbean, South America, Africa, Southeast Asia, India, Australia, and various Pacific islands, including Papua New Guinea, the Philippines, and Hawaii (Dijkman, 1950; Lim, 2011; Nguyen, 2000). Historical records suggest that it was first brought to Asian territories during the 16th and 17th centuries via trade routes, with further dispersal observed in the 19th century (Dijkman, 1950).

In specific locales such as southern Taiwan and the Penghu Islands, the species has established dense, monospecific populations since the 1980s (Chou & Kuo, 1986). Furthermore, in areas like the savannah-type landscapes of the Jinsha River valley in China, *L. leucocephala* has become a key component of ecological restoration efforts, aiding in soil stabilization and the prevention of vegetation degradation (Liu, Gao, Chen, & Li, 2018).

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

Ecological requirements

Leucaena leucocephala, commonly recognized as the "miracle tree," is a perennial leguminous species renowned for its rapid growth and broad utility (de Sousa Machado et al., 2020; Sharma et al., 2022). This highly adaptable tree exhibits a range of beneficial traits, such as swift regeneration, effective nitrogen fixation, and the ability to thrive in poor soils as well as under challenging environmental conditions like high temperatures, drought, and salinity (Buck et al., 2019; Pandey & Kumar, 2013; Sharma et al., 2022).

Although it naturally flourishes in dry tropical and subtropical climates, it also performs well in sub-humid and humid zones, making it a valuable asset in both ecological restoration and sustainable agricultural practices (Ahmed & Abdelati, 2009; Pandey & Kumar, 2013), but prefers moist environments for optimal growth (Lim, 2011). Tropical species *Leucaena leucocephala* can withstand intense heat up to 48°C, although it grows best in mild temperatures between 25 and 30°C. Higher latitudes and elevated tropical environments, especially those above 1000 m within 10° latitude of the equator and above 500 m within the 10–25° latitude zone, inhibit its growth. This species has similar drought tolerance to stylo (Bakewell-Stone, 2023; Chiou et al., 2013; Shelton & Brewbaker, 1994; Takahashi & Ripperton, 1949). However, It exhibits low tolerance to cold, with a marked decrease in growth observed throughout the winter months in subtropical areas (D'Mello & Acamovic, 1989; Kato-Noguchi & Kurniadie, 2022). In addition, the plant is extremely drought-tolerant and thrives in areas with 650–1,500 mm of annual rainfall as well as up to 3,000 mm in humid or subhumid conditions (Harris et al., 1994; Kato-Noguchi & Kurniadie, 2022; Lim, 2011). Though its growth is greatly inhibited in extended dry conditions, it can tolerate dry seasons of up to seven months, even during establishment (Chiou et al., 2013; Hajar & Mukassabi, 2016; Nehdi et al., 2014). The cold tolerance of *Leucaena leucocephala* is low. Light frost causes it to lose its leaves, and after a day at -5°C, 13% of it dies back (Honda, 2021). Thus, in arid and semi-arid regions, it is a vital dynamic characteristic that supports drought resistance and sustainable forestry (Bageel et al., 2020; Maliki, Moussaoui, Ramdani, & ELBadaoui, 2021) .

Leucaena leucocephala is a highly adaptable and drought-tolerant tree legume that thrives in warm tropical and subtropical regions (Honda, 2021; Nyambati, Sollenberger, Karue, & Musimba, 2006; Tawata, Fukuta, Xuan, & Deba, 2008). It thrives in neutral to slightly alkaline (pH 6.0–7.5), freely drained soils and is a good fit for calcareous soils, including coral-derived soils. While it can tolerate a variety of soil conditions, it struggles in highly acidic (pH below 5), nutrient-poor, saline, or waterlogged soils, as well as those with low phosphorus, low calcium, or high aluminum saturation. In frost-prone areas, the species sheds its leaves after light frosts, and severe frosts can kill above-ground growth, though trees may resprout depending on frost severity (De Angelis et al., 2021; Micosa-Tandung, 1986; Steppler & Nair, 1987). Despite these challenges, *L. leucocephala* remains an important species for agroforestry and livestock systems, particularly in acid-infertile savanna soils where poor-quality grasses limit productivity (Escalante, 2019). Thus; These characteristics enhance the invasiveness of *Leucaena leucocephala*. Its ability to fix atmospheric nitrogen also enables it to establish and persist in nutrient-poor soils, particularly in environments with limited nitrogen availability (Dhanda & Chauhan, 2022). As a result, *leucaena* is highly drought-tolerant, even over extended periods of time. The ability of *Leucaena* to thrive in tropical and subtropical regions under various stress conditions is primarily attributed to its root-related competitive traits. These include the development of a deep taproot, a high density of lateral roots, effective associations with mycorrhizal fungi, robust nodulation and nitrogen-fixing capacity, notable

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

resistance to soil-borne diseases, and an adaptive response to fluctuating water and nutrient levels in the soil (Ishihara et al., 2018). So; The fast growth of *Leucaena* and its adaptability under edaphically and environmentally assorted conditions further enhance its agro-industrial utilization (Pramod, Rao, & Sundberg, 2013).

Traditional uses and Ecological significance

Leucaena leucocephala (Lam.) de Wit is a fast-growing and versatile leguminous tree, is indigenous to southern Mexico and northern Central America, is highly valued for its multipurposes uses in agroforesty, agriculture, and industry (Ishihara et al., 2018). Its wide range of practical uses has played a key role in its broad acceptance and utilization. Traditionally, *L. leucocephala* has long been utilized as a high-protein feed for animals, especially in ruminant feeding systems, where it is frequently contrasted with alfalfa due to its nutritional content and ease of digestion (Bakewell-Stone, 2023; Buck et al., 2019; Lim, 2011). It is especially useful for controlling erosion and reclaiming marginal lands since the tree is a vital part of agroforestry systems and acts as green manure to increase soil fertility and decrease soil degradation (Dholariya et al., 2018; Jackson Araújo Silva, Andréa Celina Ferreira Demartelaere, & Pereira, 2019; Lenné, 1991; Prakash, Malik, Rani, & Verma, 2020); supplying shade for crops like pepper, coffee, chocolate, and vanilla while acting as a windbreak and living fence (Burawat et al., 2016; De Angelis et al., 2021; Jackson Araújo Silva et al., 2019; Lenné, 1991).

In addition to its role in sustainable agriculture, *L. leucocephala* provides a substantial supply of firewood; shad tree for some crops and timber, with its high caloric value making it a good choice for fuel and charcoal production (Chou & Kuo, 1986; Dhanda & Chauhan, 2022; Lok et al., 2010). Beyond agriculture and forestry, different parts of L. leucocephala plants are widely used in traditional folk medicine (Lowry, Cook, & Wilson, 1984). Notably, it has been discovered that *L. leucocephala* bark gum has a considerable capacity for swelling, indicating that it may be used as a disintegrant in tablet formulation (Nehdi et al., 2014). Additionally, the plant exhibits natural resistance to bacterial and fungal infections as well as insect pests, further highlighting its pharmacological and industrial relevance (Honda, 2021).

In several cultures, in many regions, the leaves, seeds, and pods of *L. leucocephala* are also consumed by humans, especially in Central America, Indonesia, and Thailand, where they are used in salads or as ingredients in various dishes (Ishak et al., 2021; Ishihara et al., 2018; Nehdi et al., 2014). The seeds may be utilized as concentrate feed for dairy animals, as organic fertilizer, as a protein-rich ingredient, as an oilseed, and as a potential source of commercial gum (Sethi & Kulkarni, 1995). Its ecological significance extends to used in restoration programs to rehabilitate degraded lands, reduce erosion, improve soil quality, and stabilize sand (Campbell, Vogler, Brazier, Vitelli, & Brooks, 2019).

Additionally, further highlighting its advantages for the environment, current research indicates that it is also excellent in eliminating textile colors and heavy metal pollutants, making it an essential component of soil remediation (Ishihara et al., 2018), due to its association with nitrogen-fixing bacteria, it contributes significantly to enhancing soil fertility (Jackson Araújo Silva et al., 2019). Thus, *Leucaena leucocephala* is widely acknowledged for its multipurpose uses, it is also classified among the world's 100 most invasive alien species due to its significant negative impacts on biodiversity and human activities (Chiou et al., 2013; Kato-Noguchi & Kurniadie, 2022).

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

Phenology and Germination

Leucaena leucocephala is a perennial, fast-growing legume tree widely cultivated in tropical and subtropical areas for its diverse applications, including use as animal fodder, fuelwood, and for improving soil fertility through nitrogen fixation (Ishak et al., 2021; Shelton & Brewbaker, 1994). Its phenological development is notable for early flowering, often beginning between 4 and 8 months after planting, particularly under suitable environmental conditions (Bageel et al., 2020; Steppler & Nair, 1987; C. Walton, 2003). Flowering patterns in *L. leucocephala* vary significantly across cultivars and growing environments. While it commonly flowers seasonally or twice annually, it may also bloom throughout the year in certain conditions (C. S. Walton, 2003). In some regions, especially subtropical zones, flowering intensity may increase during moisture stress or shorter photoperiods (C. Walton, 2003). Like most legumes, *L. leucocephala* has nyctinastic motions, with leaves that close in the evening and reopen in the morning. This predictable activity is controlled by an internal biological clock (Sohtome, Tokunaga, Ueda, Yamamura, & Ueda, 2002; Ueda, Sohtome, Ueda, & Yamamura, 2001). Thus, it grows rapidly and emits allelochemicals that hinder nearby plants, enabling its aggressive spread and dominance (Sohtome et al., 2002). The tree produces spherical flower heads that are white or pale cream, followed by long, flat pods filled with hard-coated seeds (Pandey & Kumar, 2013). The seeds have a hard, tough, thick, waxy seed coat which is impermeable (MacLaurin et al., 1981). According to Dhanda and Chauhan (2022), seed germination increased following a 2-minute scarification treatment, as the application of hot water facilitated the disruption of the hard seed coat responsible for primary dormancy by softening it. This process enables the population to exhibit uniform germination rates across spring, summer, and autumn seasons.. Under optimal conditions, including warm temperatures (25–30°C) and with sufficient moisture, pretreated seeds show high germination rates, typically emerging within 7 to 14 days (Sharma et al., 2022; C. Walton, 2003). These traits, combined with its adaptability, contribute to the species' invasive potential, making it difficult to manage once established (Marques et al., 2014).

Reproduction and Dispersal

Leucaena leucocephala, commonly known as *leucaena*, is a tetraploid and self-pollinated species, enabling a single plant to produce viable seeds. It can reach reproductive maturity within 12 months, or as quickly as 4 to 6 months under ideal conditions (Campbell et al., 2019; Kato-Noguchi & Kurniadie, 2022; Steppler & Nair, 1987; Whitesell & Parrotta, 2008). *Leucaena* primarily reproduces through seeds, which are produced in large numbers but exhibit physical dormancy due to their hard seed coat (Marques et al., 2014; Shelton & Brewbaker, 1994). This dormancy allows seeds to remain viable in the soil for 10 to 20 years, germinating only when conditions become favourable.

To overcome the hardness of the seed coat and promote germination, scarification is required (Dhanda & Chauhan, 2022; MacLaurin et al., 1981). The species is self-fertile but also benefits from cross-pollination facilitated by insects, particularly bees (Dhanda & Chauhan, 2022; Harris et al., 1994; Hughes, 1998; Lok et al., 2010). Dispersal occurs through several mechanisms, including wind, water, and animal ingestion like ; birds, rodents and cattle (C. S. Walton, 2003). Livestock and other herbivores play a crucial role in seed dispersal, as seeds pass through their digestive tracts and are excreted at different locations, often with improved germination rates (Clem & Hall, 1994; Marques et al., 2014).

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

Additionally, its rapid growth, high seed production, and ability to form dense thickets, combined with widespread planting for agroforestry and erosion control, have facilitated the global spread of *L. leucocephala* (Chiou, Chen, Wang, & Grant, 2016; Dhanda & Chauhan, 2022; Mohammed, El Souda, Taie, Moharam, & Shaker, 2015; Phaikaew et al., 2012). Consequently, it has been classified as an invasive species in several regions, where it outcompetes native vegetation and disrupts ecosystem dynamics (Dhanda & Chauhan, 2022; Lim, 2011; Lok et al., 2010).

CONCLUSION

Leucaena leucocephala stands as a testament to the dual nature of biological introductions, embodying both remarkable utility and ecological risk. Its rapid growth, high biomass production, and nitrogen-fixing ability have made it a cornerstone species in agroforestry, soil restoration, and sustainable agricultural practices across tropical and subtropical regions. Beyond its environmental benefits, the plant has contributed significantly to rural economies by providing livestock fodder, firewood, and timber. However, the very traits that make *L. leucocephala* advantageous have also facilitated its invasiveness, leading to displacement of native species, alteration of ecosystem functions, and biodiversity loss in some areas. Managing the spread of *L. leucocephala* requires a nuanced approach that balances its agricultural and ecological benefits against its potential to disrupt natural habitats. Future research and management strategies should focus on developing sustainable utilization practices, exploring biological control options where necessary, and promoting awareness among stakeholders about the species' dual impacts. A holistic understanding of *Leucaena leucocephala* will enable policymakers, land managers, and researchers to maximize its benefits while minimizing its environmental risks, ensuring its integration into ecosystems in a responsible and ecologically sound manner.

Acknowledgements

The authors are grateful to Laboratory of Biology, Environment, and Health - University of ECHAHID HAMMA LAKHDAR EL-OUED, for final analysis of this work.

References

1) Ahmed, M. E., & Abdelati, K. A. (2009). Chemical composition and amino acids profile of Leucaena leucocephala seeds. *International Journal of Poultry Science, 8*(10), 966-970.

2) Awe, F., Giwa-Ajeniya, A., Akinyemi, A., & Ezeri, G. (2013). Phytochemical analysis of Acalypha wilkesiana, Leucaena leucocephala, Pepperomia pellucida and Senna alata leaves. *The International Journal of Engineering and Science*, *2*(9), 41-44.

3) Bageel, A., Honda, M. D., Carrillo, J. T., & Borthakur, D. (2020). Giant leucaena (Leucaena leucocephala subsp. glabrata): a versatile tree-legume for sustainable agroforestry. *Agroforestry Systems*, *94*, 251-268. doi:https://doi.org/10.1007/s10457-019-00392-6

4) Bakewell-Stone, P. (2023). Leucaena leucocephala (leucaena). *CABI Compendium*.

5) Buck, S. R., Rolfe, J. W., Lemin, C., & English, B. H. (2019). Adoption, profitability and future of leucaena feeding systems in Australia. *Tropical Grasslands-Forrajes Tropicales, 7*(4), 303-314. doi:http://dx.doi.org/10.17138/TGFT(7)303-314

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

6) Burawat, J., Uabandit, N., Sripanidkulchai, B., Nualkaew, S., & Iamsaard, S. (2016). Antioxidant Capacity and Acute Testicular Toxicity of Leucaena leucocephala Aqueous Shoot Tips Plus Young Leaves Extracts. *International Journal of Morphology, 34*(2).

7) Campbell, S., Vogler, W., Brazier, D., Vitelli, J., & Brooks, S. (2019). Weed leucaena and its significance, implications and control. *Tropical Grasslands-Forrajes Tropicales, 7*(4), 280-289. doi:https://doi.org/DOI:10.17138/TGFT(7)280-289

8) Chiou, C.-R., Chen, Y.-J., Wang, H.-H., & Grant, W. E. (2016). Predicted range expansion of the invasive plant Leucaena leucocephala in the Hengchun peninsula, Taiwan. *Biological invasions, 18*, 381-394. doi:https://doi.org/10.1007/s10530-015-1010-4

9) Chiou, C.-R., Wang, H.-H., Chen, Y.-J., Grant, W. E., & Lu, M.-L. (2013). Modeling potential range expansion of the invasive shrub Leucaena leucocephala in the Hengchun peninsula, Taiwan. *Invasive Plant Science and Management, 6*(4), 492-501. doi:http://dx.doi.org/10.1614/IPSM-D-13-00010.1

10) Chou, C.-H., & Kuo, Y.-L. (1986). Allelopathic research of subtropical vegetation in Taiwan: III. Allelopathic exclusion of understory by Leucaena leucocephala (Lam.) de Wit. *Journal of Chemical Ecology, 12*, 1431-1448. doi:https://doi.org/10.1007/BF01012362

11) Clem, R., & Hall, T. (1994). Persistence and productivity of tropical pasture legumes on three cracking clay soils (Vertisols) in north-eastern Queensland. *Australian Journal of Experimental Agriculture, 34*(2), 161-171.

12) D'Mello, J., & Acamovic, T. (1989). Leucaena leucocephala in poultry nutrition—a review. *Animal Feed Science and Technology, 26*(1-2), 1-28. doi:https://doi.org/10.1016/0377-8401(89)90003-5

13) De Angelis, A., Gasco, L., Parisi, G., & Danieli, P. P. (2021). A multipurpose leguminous plant for the mediterranean countries: Leucaena leucocephala as an alternative protein source: A review. *Animals, 11*(8), 2230. doi:https://doi.org/10.3390/ani11082230

14) de Sousa Machado, M. T., Drummond, J. A., & Barreto, C. G. (2020). Leucaena leucocephala (Lam.) de Wit in Brazil: history of an invasive plant. *Estudos Ibero-Americanos, 46*(1), e33976-e33976.

15) Dhanda, S., & Chauhan, B. S. (2022). Seed germination ecology of leucaena (Leucaena leucocephala) as influenced by various environmental parameters. *Weed Science, 70*(3), 335-340. doi:DOI: https://doi.org/10.1017/wsc.2022.18

16) Dholariya, C., Behera, L., Patel, D., Mehta, A., Gunaga, R., & Viyol, S. (2018). Impact of different salinity levels on physiological attributes of Leucaena leucocephala Lam. in early growth stage. *IJCS, 6*(4), 2606-2609.

17) Dijkman, M. J. (1950). Leucaena—A promising soil-erosion-control plant. *Economic Botany, 4*(4), 337-349. doi:https://doi.org/10.1007/BF02985092

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

18) Escalante, E. E. (2019). Use and performance of leucaena (Leucaena leucocephala) in Venezuelan animal production systems. *Tropical Grasslands-Forrajes Tropicales, 7*(4), 407-409.

19) Godefroy, J. (1987). Contribution à l'étude de Leucaena leucocephala (LAM.) de WIT. en région tropicale. *Fruits, 42*(12), 703-708.

20) Hajar, S. F. B., & Mukassabi, T. A. (2016

21) Do Leucaena leucocephala new seedlings survive very dry climate? *The Fourth Scientific Conference of Environment and Sustainable Development in the Arid and Semi- Arid Regions*, 93-101.

22) Harris, S. A., Hughes, C. E., Ingram, R., & Abbott, R. J. (1994). A phylogenetic analysis of Leucaena (Leguminosae: Mimosoideae). *Plant Systematics and Evolution, 191*, 1-26. doi:https://doi.org/10.1007/BF00985339

23) Honda, M. D. H. (2021). *The Role of Mimosine, a Non-protein Amino Acid in Leucaena leucocephala subsp. glabrata (Giant Leucaena).* University of Hawai'i at Manoa,

24) Hughes, C. E. (1998). *Leucaena: a genetic resources handbook*.

25) Idol, T. (2019). A short review of leucaena as an invasive species in Hawaii. *Tropical Grasslands-Forrajes Tropicales, 7*(4), 290-294. DOI: https://doi.org/10.17138/tgft(7)290-294

26) Ishak, M., Iberahim, Z., & Mardiana-Jansar, K. (2021). *Comparative response of Malaysian weedy rice (Oryza sativa) initial growth towards the allelopathic potential of Leucaena leucocephala (Lam.) de Wit and Dicranopteris linearis (Burm. f.) Underw.* Paper presented at the IOP Conference Series: Earth and Environmental Science.

27) Ishihara, K. L., Honda, M. D., Bageel, A., & Borthakur, D. (2018). Leucaena leucocephala: a leguminous tree suitable for eroded habitats of Hawaiian Islands. *ravine lands: greening for livelihood and environmental security*, 413-431. doi:https://doi.org/10.1007/978-981-10-8043-2_18

28) Jackson Araújo Silva, I. R. F. S., Andréa Celina Ferreira Demartelaere, A. D. d. M., & Pereira, a. M. D. (2019). *Physiological Quality in Leucaena leucocephala Seeds Conditioned with Potassium Nitrate Submitted to Saline and Water Stresses*. Journal of Experimental Agriculture International.

29) Kato-Noguchi, H., & Kurniadie, D. (2022). Allelopathy and allelochemicals of Leucaena leucocephala as an invasive plant species. *Plants, 11*(13), 1672. doi:https://doi.org/10.3390/plants11131672

30) Kuppusamy, U. R., Arumugam, B., Azaman, N., & Jen Wai, C. (2014). Leucaena leucocephala fruit aqueous extract stimulates adipogenesis, lipolysis, and glucose uptake in primary rat adipocytes. *The Scientific World Journal, 2014*(1), 737263. doi:https://doi.org/10.1155/2014/737263

31) Lenné, J. M. (1991). Diseases of Leucaena species. *International Journal of Pest Management, 37*(3), 281-289. doi:https://doi.org/10.1080/09670879109371600

32) Lim, T. (2011). Leucaena leucocephala. In *Edible Medicinal And Non-Medicinal Plants: Volume 2, Fruits* (pp. 754-762): Springer.

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

33) Liu, F., Gao, C., Chen, M., & Li, K. (2018). Above-and below-ground biomass relationships of Leucaena leucocephala (Lam.) de Wit in different plant stands. *PLoS One*, *13*(11), e0207059. doi:https://doi.org/10.1371/journal.pone.0207059

34) Lok, A., Tan, K.-x., Ang, W., & Tan, H. (2010). The distribution and ecology of Leucaena leucocephala (Lam.) de Wit ssp. leucocephala (Fabaceae) in Singapore. *Cosmos, 6*(01), 45-55. doi:https://doi.org/10.1142/S0219607710000462

35) Lowry, J. B., Cook, N., & Wilson, R. D. (1984). Flavonol glycoside distribution in cultivars and hybrids of Leucaena leucocephala. *Journal of the Science of Food and Agriculture*, *35*(4), 401-407. doi:https://doi.org/10.1002/jsfa.2740350407

36) MacLaurin, A., Tainton, N., & Bransby, D. (1981). Leucaena leucocephala (lam.) de wit as a forage plant-A review. *Proceedings of the Annual Congresses of the Grassland Society of Southern Africa, 16*(1), 63-69. doi:https://doi.org/10.1080/00725560.1981.9648922

37) Maliki, I., Moussaoui, A. E., Ramdani, M., & ELBadaoui, K. (2021). Phytochemical screening and the antioxidant, antibacterial and antifungal activities of aqueous extracts from the leaves of Salvia officinalis planted in Morocco. *Moroccan Journal of Chemistry*, *9*(2), 9-2 (2021) 2354-2368. doi:https://doi.org/10.48317/IMIST.PRSM/morjchem-v9i2.24840

38) Marod, D., Duengkae, P., Kutintara, U., Sungkaew, S., Wachrinrat, C., Asanok, L., & Klomwattanakul, N. (2012). The Influences of an Invasive Plant Species (Leucaena leucocephala) on Tree Regeneration in Khao Phuluang Forest, Northeastern Thailand. *Agriculture and Natural Resources, 46*(1), 39-50.

39) Marques, A., Costa, C., Atman, A., & Garcia, Q. (2014). Germination characteristics and seedbank of the alien species Leucaena leucocephala (Fabaceae) in Brazilian forest: ecological implications. *Weed Research, 54*(6), 576-583. doi: https://doi.org/10.1111/wre.12107

40) Micosa-Tandung, L. (1986). Biomass prediction equations for giant ipil-ipil (Leucaena leucocephala (Lam.) de Wit).

41) Mohammed, R. S., El Souda, S. S., Taie, H. A., Moharam, M. E., & Shaker, K. H. (2015). Antioxidant, antimicrobial activities of flavonoids glycoside from Leucaena leucocephala leaves. *Journal of Applied Pharmaceutical Science, 5*(6), 138-147. doi:https://doi.org/doi:10.7324/JAPS.2015.50623

42) Nehdi, I. A., Sbihi, H., Tan, C. P., & Al-Resayes, S. I. (2014). Leucaena leucocephala (Lam.) de Wit seed oil: Characterization and uses. *Industrial Crops and Products, 52*, 582-587. doi:https://doi.org/10.1016/j.indcrop.2013.11.021

43) Nguyen, D. H. (2000). Utilisation des feuilles de Leucaena leucocephala dans les aliments pour poulets de chair (French text).

44) Nyambati, E., Sollenberger, L., Karue, C., & Musimba, N. (2006). The value of Acacia brevispica and Leucaena leucocephala seedpods as dry season supplements for calves in dry areas of Kenya. *African Journal of Agricultural Research, 1*(4), 118-124.

45) Orwa, C. (2009). Agroforestree Database: a tree reference and selection guide, version 4.0. *http://www. worldagroforestry. org/sites/treedbs/treedatabases. asp*.

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

46) ORWA, C., MUTUA, A., KINDT, R., JAMNADASS, R., & SIMONS, A. (2009). Agroforestree. A tree reference and selection guide, version 4.0. Retrieved July 02, 2012. In.

47) Pandey, V. C., & Kumar, A. (2013). Leucaena leucocephala: an underutilized plant for pulp and paper production. *Genetic resources and crop evolution, 60*, 1165-1171. doi:https://doi.org/10.1007/s10722-012-9945-0

48) Phaikaew, C., Suksaran, W., Ted-Arsen, J., Nakamanee, G., Saichuer, A., Seejundee, S., . . . Shelton, H. (2012). Incidence of subclinical toxicity in goats and dairy cows consuming leucaena (Leucaena leucocephala) in Thailand. *Animal Production Science, 52*(4), 283-286. doi:https://doi.org/10.1071/AN11239

49) Prakash, O., Malik, S., Rani, K. V., & Verma, V. K. (2020). Phytochemical screening and bioactive potential of pod seed extracts of Leucaena leucocephala Linn. *Pharmacognosy Research, 12*(4). doi:https://doi.org/10.4103/pr.pr_49_20

50) Pramod, S., Rao, K. S., & Sundberg, A. (2013). Structural, histochemical and chemical characterization of normal, tension and opposite wood of Subabul (Leucaena leucocephala (lam.) De wit.). *Wood Science and Technology, 47*, 777-796. doi:https://doi.org/10.1007/s00226-013-0528-9

51) Raman, V., Rana, A., & Sarma, A. (2018). Phytochemical Analysis & Anthelmintic Activity of Leaves of Leucaena Leucocephala. *World Journal of Pharmaceutical Research, 7*(11), 24. doi:https://doi.org/DOI:10.20959/wjpr201811-12411

52) Sethi, P., & Kulkarni, P. R. (1995). Leucaena leucocephala A nutrition profile. *Food and Nutrition bulletin, 16*(3), 1-16. doi:https://doi.org/10.1177/1564826595016003

53) Sharma, P., Kaur, A., Batish, D. R., Kaur, S., & Chauhan, B. S. (2022). Critical insights into the ecological and invasive attributes of Leucaena leucocephala, a tropical agroforestry species. *Frontiers in Agronomy, 4*, 890992. doi:https://doi.org/10.3389/fagro.2022.890992

54) Shelton, H., & Brewbaker, J. (1994). Leucaena leucocephala-the most widely used forage tree legume. *Forage tree legumes in tropical agriculture.(Eds. RC Gutteridge and HM Shelton). CAB International. Wallingford, UK, 15*.

55) Soedarjo, M., & Borthakur, D. (1996). Simple procedures to remove mimosine from young leaves, pods and seeds of Leucaena leucocephala used as food. *International journal of food science & technology, 31*(1), 97-103. doi: https://doi.org/10.1111/j.1365-2621.1996.24-321.x

56) Sohtome, Y., Tokunaga, T., Ueda, K., Yamamura, S., & Ueda, M. (2002). Leaf-closing substance in Leucaena leucocephala. *Bioscience, biotechnology, and biochemistry, 66*(1), 51-56. doi:https://doi.org/10.1271/bbb.66.51

57) Steppler, H. A., & Nair, P. R. (1987). *Agroforestry: a decade of development*.

58) Takahashi, M., & Ripperton, J. C. (1949). Koa haole (Leucaena glauca). Its establishment, culture and utilization as a forage crop.

59) Tawata, S., Fukuta, M., Xuan, T. D., & Deba, F. (2008). Total utilization of tropical plants Leucaena leucocephala and Alpinia zerumbet. *Journal of pesticide science, 33*(1), 40-43. doi:https://doi.org/doi:10.1584/jpestics.R07-10

Volume 64 | Issue 06 | June 2025
DOI: 10.5281/zenodo.15720531

60) Ueda, M., Sohtome, Y., Ueda, K., & Yamamura, S. (2001). Potassium 2, 3, 4-trihydroxy-2-methylbutanoate, a leaf-closing substance of Leucaena leucocephalam. *Tetrahedron Letters*, *42*(17), 3109-3111. doi:https://doi.org/10.1016/S0040-4039(01)00380-X

61) Walton, C. (2003). The biology of Australian weeds. 42. Leucaena leucocephala (Lamark) de Wit. *Plant Protection Quarterly*, *18*(3), 90-98.

62) Walton, C. S. (2003). *Leucaena (Leucaena leucocephala) in Queensland*: Land Protection, Department of Natural Resources, Mines, and Energy.

63) Whitesell, C., & Parrotta, J. A. (2008). Leucaena leucocephala (Lam.) de Wit. *Woody Plant Seed Manual*.

64) Zarina, Z., Ruzaidi, C., Sam, S., Bakri, A., & Aminah, M. (2018). *Bioactive compound analysis in seeds of Leucaena leucocephala (Petai Belalang).* Paper presented at the AIP Conference Proceedings.