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RESEARCH ARTICLE

SEVERE OUTBREAK OF WHITE ROT CAUSED BY A VIRULENT *GANODERMA LEBBEKICOLA* SP NOV. AFFECTING *ALBIZZIA LEBBECK* IN KURKSHETRA: PATHOLOGY, IDENTIFICATION AND MANAGEMENT

[1,2]Aneja, K.R

[1]Former Professor and Chairman, Department of Microbiology, Kurukshetra University Kurukshetra - 136119, India
[2]Honorary Professor and Research Advisor, Sardar Bhagwan Singh University, Dehradun, India

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ABSTRACT

This two years study investigates a severe diseases outbreak causing heavy economic and environmental losses in a public park at Kurukshetra, Haryana (India), where a virulent strain of the white-rot fungus *Ganoderma* species caused a heavy mortality rate of 75 % of *Albizzia lebbek* (siris) trees. Field survey revealed that the hyphal colonization targets the lignin and cellulose within the root xylem and vascular cambium, disrupting water and nutrient translocation. This leads to progressive crown wilting, bark splitting at the collar region, and eventual tree's mortality. This fungal pathogen is identified a new species of *Ganoderma* (stipitate, varnished, kidney- to fan - shaped, reddish- brown shiny cap with concentric zones, a lateral small stipe, and creamish underneath), infecting exclusively *A. lebbek* population, revealing host specificity. This taxon is distinct than other species reported on *A. lebbek* and is named *Ganoderma lebbekicola* sp nov. The disease can be treated by using chemical fungicide (e.g., hexaconazole, propiconazole, or Bavistin), myco-fungicide (*Trichoderma harzianum* or *T. viride*), or integrated applications of both, and preventing the dispersal of conks in the fields.

Corresponding author: Aneja, K.R

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INTRODUCTION

Ganoderma, a wood-decaying polypore fungal taxon with species ranging between 191 and 322 distributed globally, known for causing devastating root- and basal stem rots across both forestry crops and perennial trees, including *Albizzia lebbek* (commonly known as the Siris tree or Woman's tongue). *Ganoderma* as a white- rot fungus has the ability to produce cellulases, and ligninases and attacks tree's lower trunk ("butt"), degrading lignin and cellulose in the internal tissues, compromising structural integrity causing dieback disease and finally resulting in host's death.

ALBIZZIA LEBBEK TAXONOMY

Albizzia lebbek (L.) Benth. (Commonly called Siris, Indian Siris, Lebbek, and woman's tongue tree), a member of the family *Fabaceae* (*Leguminosae*), is a native to the Indian subcontinent and Myanmar (Lowry and Seebeck, 1997; Plummer, 2020). It is a fast - growing, huge deciduous tree, reaching 18 -20 meters in height. It is highly revered in traditional Indian medicine. In Ayurveda, it is known universally by its classical Sanskrit name, Shirisha or Sirisa, holding an elite status as one of the foremost Vishaghna (anti-poisonous against venomous insect bites, scorpion bites, and detoxifying bloodborne toxins), in addition to anti-allergic and respiratory disorders (asthma, cough) (Verma *et al*., 2013). Currently, it is widespread in occurrence across tropical and subtropical zones, including Northern Australia, Southeast Asia, Tropical Africa, and the Americas. In India, Siris is highly valued in social forestry, roadside avenues, and parks. It is characterized by bi-pinnate leaves, large straw -coloured pods (fruits) that rattle loudly in the wind (earning it the English moniker "Woman's Tongue tree"), and fragrant, creamish- white or pale - yellow pompom - like flowers (Figure 1).

ECONOMIC AND ENVIRONMENTAL LOSSES: Economically, this wood-decaying fungus destroys highly valuable timber that is otherwise heavily traded for high quality furniture, housing construction, and agricultural implements. The economic loss for removing a single 50- feet mature *A. lebbek* tree killed by *Ganoderma* root rot typically ranges from $1500 to $3500, which accounts for professional hazardous sectional tree felling, complete stumps grinding, and extensive root extraction necessary to eradicate the soil-borne fungus. When *Ganoderma* decimates 75% of the trees in a park, the compounding environmental consequences drastically degrade the ecosystem's vital functions and services

Figure 1. *Albizzia lebbek:* A tree with characteristics leaves, flowers and fruits

(SAVATREE, 2025). Environmentally, the early death of these massive canopy trees triggers a sharp drop in localized oxygen (O_2) production and diminishes the region's overall carbon sequestration capacity. Furthermore, *A. lebbek* being a robust nitrogen- fixing legume, it's premature decay/ death halts nitrogen fixation affecting soil fertility. Stripping the park of its lush shade canopy destroys its aesthetics, natural beauty, recreational appeal, and permanently degrades the area's natural heritage.

***GANODERMA - A. LEBBEK* PATHOLOGICAL ASSOCIATION:** *Ganoderma* (*gano* means shine and *derma* means skin, basidiocarps with shining skin), a wood-decaying polypore, having species ranging from 191 to 322 distributed globally. Species originating from historical indexing in global fungus name (CABI Bioscience databases) mentions 322 species (Flood *et al*., 2000), which have been narrowed down to 191 species based upon the recent molecular/ phylogenetic analysis in *Ganoderma* (He *et al*., 2024). Worldwide, *G. lucidum, G. applanatum, G. australe, G. philippii* and *G. lesklokorka* are widely reported causing damage to *Albizzia* hosts. *G. lucidum* (commonly called Lingzhi or Reishi) is the most prominent and aggressively reported pathogen causing root rot and butt rot of *A. lebbek* globally, including India. It acts as a soil- borne facultative parasite that targets the root system and collar region, leading to significant tree mortality across arid and semi-arid plantation regions. The pathogen infects hosts via dispersal of basidiospores and direct root-to-root contact (Bakshi, 1971, 1976; Sharma and Bhardwaj, 2001; Passie *et al*., 2002; Sankaran *et al.,* 2005; Allen *et al*., 2009; Mafia *et al*., 2020).

PATHOGENESIS

Ganoderma infection in tree's roots occurs by both germinating basidiospores (spore germination is followed by the mating of two compatible strains, resulting to infective dikaryotic mycelium) in exposed root flares, tree wounds and surface roots; and soil-borne mycelial contact through uninjured or injured deep root system. The mycelial contact is generally considered the primary method for root rot and basal stem rot. The mechanism of infection and life cycle of *Ganoderma* is diagrammatically shown in Figure 2 (Khoo and Chang, 2023).

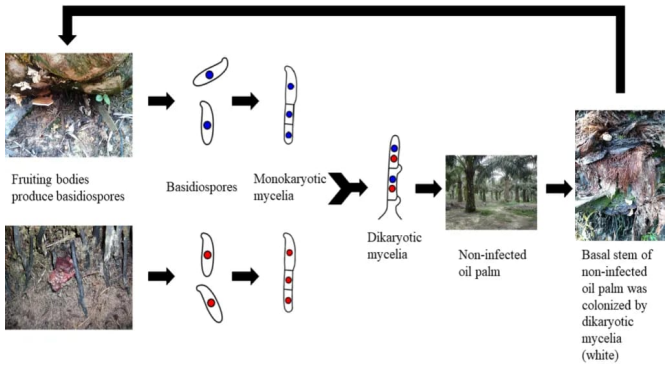

Figure 2 Pathogenesis and disease cycle in *Ganoderma*. (Source: Khoo and Chong, 2023)

RESULTS AND DISCUSSION

Observation for the *Ganoderma* infection status were made in the: Sector-2, Urban Estate, Kurukshetra park during the years 2025-2026. An analysis of the 51 total *A. lebbek* trees surveyed, during the rainy season of 2026 revealed a devastating disease intensity. Out of 51 trees, only 13 were found to be healthy (25.5%), meaning 74.5% of the park's population has been severely impacted or killed by the *Ganoderma* outbreak (Figure 3). The comprehensive breakdown of the impact data organized is given in Table 1.

Figure 3. *Ganoderma-A. lebbek* pathological association. Basidiocarp development stages (1-5), Dieback symptoms (7), Basidiocarps growing at the trunk's base (6,8) and Basidiocarps growing away from the trunk (up to 7-8 feet) (9)

Table 1: The breakdown of the *Ganoderma* impact data on *A. lebbek*

Tree condition/ Disease manifestation	Number of trees	Percentage of total (%)	Health classification
Healthy (Without any disease symptoms)	13	25.49%	Infection free
Live trees with only dead crowns	13	25.49%	Actively declining
Standing dead (Without crown and leaves	10	19.61%	Dead
Dead stumps (only 1 foot remaining	11	21.57%	Dead
Completely killed (Cut and lying on the soil)	3	5.88%	Dead
Standing resprouting stump	1	1.96%	Critical
Total Population Surveyed	**51**	**100.00%**	**74.51% Impacted**

KEY ECOLOGICAL OBSERVATIONS FOR THIS SITE

High Inoculum Load: With 24 dead stumps or cut logs sitting directly on or in the soil, the ground in Sector 2 is heavily saturated with *Ganoderma* fungal mycelium, posing an immediate threat to the remaining 13 healthy trees.

Loss of Nitrogen-Fixing Benefit: The 38 infected or dead trees represent a near-total halt of natural nitrogen fixation in this specific park zone, which will rapidly deplete soil quality for surrounding undergrowth.

BASIDIOCARP DEVELOPMENT

The development of basidiocarps begins with the liberation of haploid basidiospores from the pores of a mature fruiting body. Because this polypore is strictly *heterothallic*, a single spore cannot complete the life cycle on its own. Instead, it must germinate into a haploid *monokaryotic mycelium* and encounter a compatible mate. This mating process is governed by a tetrapolar (bifactorial) incompatibility system, requiring compatibility at both the A and B mating-type loci for successful plasmogamy (Aneja and Mehrotra, 2026). Once compatible monokaryons fuse, they establish a fertile dikaryotic mycelium containing two distinct nuclei per cell, which serves as the main vegetative growth phase. Under optimal environmental tiggers – such as high humidity, dropped temperatures, and elevated carbon dioxide – the dikaryotic mycelial cords aggregate to initiate *basidiocarp primordia,* often referred to as the "button" stage (Figure 3). As development progresses, the fungus exhibits strong positive phototropism, causing the primordium to elongate into a distinct, varnished stipe/stalk. The tip of this stalk eventually expands horizontally into a fan-shaped pileus (cap) (Figure 3). The underside of the mature cap develops a porous hymenophore where karyogamy and meiosis occur within the basidia, ultimately leading to the production and subsequent liberation of a new generation of basidiospores. The mature basidiocarps of *Ganoderma* are called conks due to their unique, non- traditional mushroom shape and hard woody texture, unlike typical soft caps and gills in *Agaricus*.

DIEBACK DISEASE

The **dieback disease** in Siris occurs when *Ganoderma* attacks the tree through injuries or basal bark wounds, causing extensive root and butt rot. As a white- rot pathogen, the fungus releases specialized enzymes: the cellulases and ligninases that systematically degrade the tree's structural lignocellulosic constituents (Aneja and Mehrotra, 2026). This destruction chokes the vascular system, starving the upper canopy of water and nutrients. This internal block manifests externally as yellowing leaves, progressive branch death from the top downward (hence called dieback disease) (Figure 3).

and the appearance of woody, shelf - like fruiting bodies (conks) at the lower trunk, especially at the soil surface (Figure 3). A mature tree typically succumbs or loses total structural integrity within 3 to 5 years after visible canopy symptoms begin to appear. In the current study, the highly destructive white - rot fungus associated with *A. lebbek* at Kurukshetra is identified as a species of *Ganoderma*. Macroscopically, the fruiting bodies (basidiocarps) are fan- to kidney- shaped, upper surface reddish -brown with white edge and the porous white undersides, and stipitate i.e., provided with a small woody stipe (Figure 3) for easy liberation and dispersal of basidiospores. The fruiting bodies on the infected roots and basal stem parts are not observed during the drier and winter months and observed only during the rainy seasons of the study period. The presence of conks on *A. lebbek* acts as an immediate diagnostic indicator of heartwood rot. It signifies that the internal vegetable mycelium had already colonized the interior heartwood, causing advanced white-rot and structural decay before erupting outward to reproduce (Figure 3).

TAXONOMY OF THE PATHOGEN

The identification of the fungus was made following the Monograph of Moncalvo and Ryvarden (1997), Mafia *et al*. (2020) and Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology (Aneja, 2023). Mafia *et al*. (2020) identified nine *Ganoderma* spp. associated with different trees in tropical moist deciduous forest region of Bangladesh such as *G. lucidum* (*Albizzia procera*, *Terminalia arjuna*, and *Dalbergia sissoo*), *G. applanatum* and *G. praelongum* (*T. arjuna*), *G. lipsiense* (*Azadiracta indica*), *G. pfeifferi* (*Acacia auriculiformis*), *G. tsugae* (*Terminalia bellircia*), *G. boninense* (*Dalbergia sissoo*), and *G. lesklokorka* (*Albizzia lebbek*). On the contrary, in the present study an interesting observation made is that other trees growing in the park including *T. arjuna*, *D. sissoo*, *Acacia arabica, Azadirachta indica, Mangifera indica, Ficus religiosa* and *Terminalia bellirica*) growing in this park, even very close to the infected *A. lebbek* trees, are not infected by this *Ganoderma* isolate. This indicates that this fungus is highly distractive and host-specific. An appropriate scientific name for this novel fungus, assuming it belongs to the genus *Ganoderma* due to its morphological or taxonomic proximity to multi-host *G. lucidum*, is named *G. lebbekicola* sp nov. highlighting its strict host - specificity and aggressive pathogenicity towards *Albizzia lebbek*.

MANAGEMENT STRATEGIES

To effectively manage *Ganoderma* root rot and butt rot in the declining *A. lebbek* population- where severe die- back canopy symptoms have left only a 25% survival rate - an integrated management system combining chemical, biological, and physical intervention, is essential. For chemical control,

localized soil drenching around the root zone using potent systemic or contact fungicides such as Copper oxychloride, Bavistin (carbendazim), or propiconazole is highly effective at halting the radial expansion of mycelium in *G. lucidum*. This chemical approach be paired with biological control strategy, specifically introducing hyper-parasitic fungi like *Trichoderma harzianum* or *T. viride*, which aggressively outcompete and suppress the pathogen in the rhizosphere (Ingle *et al*., 2024). To prevent future mishaps and safeguard the remaining healthy trees in the area, landscape managers must strictly avoid mechanical wounding of tree trunks and roots by lawnmowers or trimmers - as open wounds serve as the primary entry point for airborne basidiospores- while immediately extracting, isolating with trenches, and burning highly degraded stumps and visible conks (Nirwan *et al*., 2016).

RECOMMENDATION

To help manage this ecological crisis in Kurukshetra, the following measures are to be adopted:

Soil drenching or bio-control treatments to protect the 13 healthy trees. Safe disposal methods for the cut logs to prevent basidiospores from spreading to nearby sectors. *Ganoderma*-resistant shade trees are recommended for replanting in Haryana's climate.

CONCLUSION

This study underscores the devastating impact of a highly virulent, host specific species of *Ganoderma* named as *G. lebbekicola* sp nov., identified by laccate basidiocarps (i.e., having a shiny, varnished, or waxy surface that looks like it is coated in lacquer), which caused a critical mortality rate in the *A. lebbek* population of Kurukshetra. A long-term management strategy using eco - friendly myco-fungicides (*Trichoderma* spp.), and strictly avoiding mechanical wounding of tree trunks and roots, are needed to safe guard urban parks from epidemic tree mortality.

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