

REVIEW ARTICLE

Ganoderma lucidum: As Calamitous and Salutory Mushroom

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ABSTRACT

Ganoderma lucidum, an oriental fungus commonly called as Reishi mushroom, has a long history of traditional use for promoting health and longevity in China, Japan, and other Asian countries. It is an excellent medicinal mushroom even then it is also the causal organism of one lethal disease of coconut known as basal stem rot, foot rot and *Ganoderma* wilt, which was first reported in the country in Thanjavur in Tamil Nadu in 1952, has since been reported in Karnataka, Andhra Pradesh, Gujarat and in various places in Kerala. Apart from the devastating effect on coconut plant, it has some very useful medicinal benefits. Research on this mushroom has shown that polysaccharides and tri-terpenoids are the major active ingredients triggering the human immune system. Recent pharmacological and clinical studies suggest that this mushroom is a blood-thinner and exhibits anti-cancer/anti-tumour effects. It is also effective against Hepatitis - B and lowers blood glucose and blood pressure. Both beneficial as well as deleterious characteristics of *Ganoderma lucidum* summarized in the present review article.

Key words: *Ganoderma lucidum*, Medicinal importance, Reishi mushroom, Stem bleeding, Tanjore wilt

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INTRODUCTION

Reishi is a basidiomycete, lamella less [1] parasite having a place with the group of Polyporaceae [2, 3]. Reishi (*Ganoderma lucidum*) otherwise called "lingzhi" in china and "mannetake" (the mushroom of immortality) in japan [4, 5]. The name lingzhi represents the mix of spiritual potency and essence of immortality in Chinese. It is viewed as the "herb of profound strength" [6] representing achievement, prosperity, divine force, and life span. It is red-stained, kidney-moulded cap and incidentally, embedded stem gives it a distinctive fan-like appearance [7, 8]. It is generally found in wooded mountainous regions where the moisture level in atmosphere is high and dim lighting. It is rarely found because it thrives on dried trunks of dead plum, guercus serrata or pasonia trees [2]. In fact, the development of Reishi mushroom out of 10,000 matured trees is 2-3 only. This value is almost negligible. Reishi mushroom is also known as "mysterious mushroom" because on one side it has some good medicinal properties but on other hand, it causes the most devastating disease of a coconut known as "Thanjavur wilt" [9-10]. In India, coconut (*Cocos nucifera L.*) is a substantial crop [11]. Coconut can be utilized for many purposes such as nutritious beverages, several nutritious items like oil for edible and non-edible uses and fibres for commercial uses and modern employments, for example, an assortment of random items for utilizing like crafted work etc [12]. In India, the reduction in production of coconuts and loss of palms occurs due to Tanjore diseases [13]. Coconut palm is affected by several diseases even though it is solid in nature and adaptable to different harsh weather conditions [10, 14]. Basal stem rot is one of the most destructive diseases among them [15] accounting for severe yield loss in southern parts of India. This disease is also known as *Ganoderma* wilt (Andhra Pradesh) or Thanjavur wilt (Tamil Nadu) or Bole rot or anabe roga (Karnataka) in different parts of India [16]. Butler, firstly reported this disease in palms [17, 18]. This disease has a symptom of yellowing and drooping of leaves followed by exudation of reddish-brown fluid through cracks at the base of the trunk and oozing spread [19-20]. Rotting of tissues at draining point and decaying of the basal part of the stem the bark turns fragile and frequently gets stripped off in pieces, leaving open breaks and cleft. The inner tissues are colourless, disintegrated and discharging a bad

odour. Section formation at the base of the trunk occurs during the rainy season [21]. Eventually, the palm dies off. Reishi mushroom is generally found on the trunk of the coconut plant.

Apart from the devastating effect on coconut plant, it has some very useful medicinal benefits. Reishi, *Ganoderma spp.*, has been known in Japan, China, and different nations as a food and unpolished material for the improvement of medications. Even though the fruiting assortment of *G. lucidum* has been utilized as a conventional home-grown medication since old occasions, the spores came to be used uniquely in the late twentieth century [22]. The spores contained bioactive substances, essentially lanostane-type triterpenes [23] and polysaccharide [24] like those in the fruiting body [25]. Ongoing investigations have demonstrated that the carcinostatic substance in Reishi is a polysaccharide, β -(1—3)-D-glucan. This polysaccharide appears to have assurance as another novel type of carcinostatic agent which may be helpful in immunotherapy. its impact depends on the advancement of the host's immune system. Dissimilar to general carcinostatic specialists it gives off an impression of being nontoxic. Reishi additionally appears to contain different substances which diminish circulatory strain, blood cholesterol, and glucose levels; and repress platelet accumulation, etc [26]. The fame of taking *G. lucidum* as an alternative medication has been expanding in cancer patients [27].

REISHI MUSHROOM

Ganoderma lucidum (commonly known as Reishi mushroom and Lingzhi) has been a financially significant species, especially in the Far East nations for more than 4000 years [28]. It is generally become on a business scale and is regularly bought for its curative and thoughtful properties. Around the world, more than 250 *Ganoderma* species have been shown. Be that as it may, in restorative practices and writing references, *Ganoderma* normally indicates the types of *G. lucidum*. Other than being valued for its therapeutic incentive in China for more than the 1000 year, the absence of accessibility of *G. lucidum* was additionally to a great extent liable for it being so profoundly valued and costly. This yearly mushroom develops on a wide range of dead or failing trees, e.g., deciduous trees. It is red-stained, kidney-moulded cap and incidentally, embedded stem gives it a distinctive fan-like appearance [7-8]. It is also known as a shiny mushroom because of its shiny appearance. Newly formed Reishi mushroom gets going white, and the underside holds this tone. However, the conk turns red or orange and builds up a sheen as it develops. It is also known as a shiny mushroom because of its shiny appearance. Truth be told, *Ganoderma* signifies "glossy skin," and also called "stained conk" due to its wet or painted appearance. By the passing of time, the sheen has started fading its colour and give a dull look. Dullness may likewise show late spore discharge; a few spores settle very near the mushroom.



Fig 1: Basal stem rot - bracket formation

Source: https://image.freepik.com/free-photo/lingzhi-mushroom-growing-trees_45334-35.jpg https://agritech.tnau.ac.in/crop_protection/images/coconut_diseases/N1.2.jpg

CALAMITOUS EFFECT OF REISHI MUSHROOM:

Thanjavur Wilt

A) Incidence and Spreading:

In the year of 1913 in India, *Ganoderma lucidum* was first recorded in Karnataka state by Butler [17]. The disease as Thanjavur wilt was first seen in Thanjavur District of Tamil Nadu after the 1952 and 1956 cyclone [13]. Critical damages are done by *Ganoderma lucidum* to coconut and other lasting crops like

areca nut, oil palm, agro-forestry trees and tea, particularly in Asia. Basal stem rot is generally common in seaside sandy soils or sandy topsoil soils where coconut is raised under rainfed conditions and much consideration was not paid for social practices [29-30]. Nonetheless, the infection is not bound to a specific soil type [29]. Studies on the basis of seasonal incidence of the disease found that the incidence of disease was more frequently happened in between the months of March and August. In these months' symptoms like bleeding and number of death palms were more. More number of deaths happen during summer however the various manifestations are available consistently. By and large, palms capitulate to basal stem rot inside a few long periods of the beginning appearance of indications. However, there were some cases in India where unexpected death happens within a half year of the appearance of beginning indications. Once in a while the palms endure the underlying assault and live for various years [13].

B) Symptoms:

The illness creates various indications on roots, stem and crown area of the palm and identification of the infection is regularly mistaken for stem bleeding diseases (Fig 2). Infection manifestations progress gradually, however normally every time infected plant dies at last. Beginning manifestations of Tanjore wilt (*Ganoderma* wilt) start with yellowing and hanging of the external whorl of leaves [31]. This is trailed by exudation of reddish-brown fluid through breaks at the base of the stem and oozing spread upwards. Rotting of tissues at draining point and spoiling of the basal part of the stem the bark turns weak and regularly gets stripped off in pieces, leaving open breaks and hole. The inside tissues are stained, broken down and producing an awful stench. Section development at the base of the trunk during the rainy season. Eventually, the palm ceases to exist.

Root: The pathogen initially taints the root framework and during the beginning phase of contamination no outside infection is visible. At first, a couple of roots get contaminated and rot. Broad spoiling and staining of root framework are a trademark manifestation of the infection [32].

Shoot: From the roots, the disease gradually advances up the stem prompting interior crumbling of cortical and stele tissues. Exudation of reddish coloured gooey liquid from the basal segments of the stem is the main obvious manifestation of the disease in the influenced palm. At that point, the spoiling would have advanced from the bole to the basal segment of the stem [33]. Bleeding on the stem starts at the base and may reach out up to 15 feet in serious cases (Fig 1 & 2).

Crown: The pamphlets display shrivelling manifestations and a couple of external whorls of leaves turn yellow [34]. Afterwards, the display light to moderate browning followed by hanging and drying. As the disease propels, the excess leaves additionally hang down one after another and the axle alone remains. As the disease advances, number of blossoms, number of catches diminishes and ordinary improvement is captured prompting button shedding. The leaves hang down bringing about hanging down of the subtended bundles. Palms matured 10 years and more established were more helpless to the disease than youthful palms.



Fig 2: Stem Bleeding of Coconut due to Tanjore Wilt

Source: https://agritech.tnau.ac.in/crop_protection/coconut_diseases_1.html

C) Etiology:

The genus *Ganoderma* has a place with the family Ganodermataceae of Basidiomycota which causes white decays in numerous woody plants by decaying lignin as well as cellulose and related polysaccharides [35]. The elevated mycelium of *Ganoderma* is hyaline, dainty walled, stretched with incessant clip associations, richly formed chlamydospores which are marginally thick-walled, terminal or intercalary, ellipsoid and some of the time in chains [36]. Cuticular cells from crustose layer are hyaline to light brown, round to irregular in shape and firmly stuffed [33]. The fruiting body is lasting, stipitate,

ordinarily sidelong, at times sessile, corky turning out to be woody later. The palisade hyphae are about 40 μ m long and are impregnated with a dim orange staining substance which they emit [Fig 3(a)]. The hymenial surface is whitish or on the other hand, creamy and turning earthy coloured later, little pores. Pore tubes are around 6-7 mm long, basidiospores [fig 3(b)] are earthy coloured, thick-walled, minutely wartlike [35].

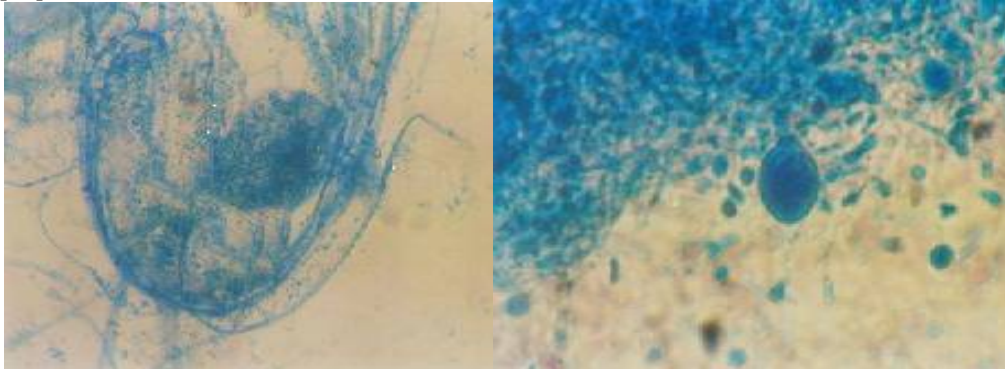


Fig 3: (a) Hyphae of *Ganoderma*; (b) Spores of *Ganoderma*[37]

D) Epidemiology:

Basal stem rot disease is a deadly disease influencing youthful and effectively bearing trees and recuperation is very rare after disease infection [13]. By and large, palms matured previously 15 years alone are contaminated with basal stem rot disease. The disease is generally common in sandy soils and where coconut gardens are raised under rainfed conditions [33]. Lack of soil dampness during late spring months, presence of old tainted stumps in the nursery, injury to roots and non-selection of suggested social practices supported the disease spread [38, 39]. Soil dampness stress experienced during mid-year months was found to support the spread of the disease. Role of climate factors, for example, temperature, downpour fall, blustery days, relative dampness on infection advancement was studied. Ramapandu *et al.* (1981) revealed that illness spread was more when the scope of distinction in relative humidity was higher and precipitation was lesser [40].

E) Disease Management

The infection is considered generally dangerous as it gets away from early indications and having different safe stages, for example, safe mycelium, chlamydospores, basidiospores and pseudosclerotia. Different trials are going on in the country for infection opposition and to discover successful administration measures[41]. None of the germplasm screened against the infection appeared protection from the disease. A few management trials were conducted utilizing nutritional, social, organic and chemical compound measures against the infection[40]. In any case, consequences of the infection the board trials depend on soil condition, age of the crop, phase of disease advancement and climate boundaries of that specific territory.

Cultural Management

Different social furthermore, wholesome administration measures were read for containing seriousness of the infection[42]. The strategies incorporate digging isolation trenches, evacuation and burning of dead contaminated plant material, abstaining from furrowing and flood water system, developing intercrops etc. [43]. Destruction of dead and rotted plant material was recommended by numerous specialists [44].

Biological Management

Antagonistic microorganisms, for example, *Trichoderma* species, *Pseudomonas fluorescens*, *Bacillus subtilis* are announced against *Ganoderma spp.* in India [45]. Application of 5 to 10 kg neem cake for every palm every year empowered saprophytic soil microflora particularly *Trichoderma* in coconut basins and was successful in the control of Basal stem rot. Application of 50 g of *Trichoderma viride*[46] alongside 5 kg of neem cake per palm every year controlled the straight spread of Basal stem rot inside a time of four months. *Pseudomonas fluorescens* was accounted for to have opposing action against *Ganoderma spp.* [47] under *in vitro* conditions. Frequency of use of bioagents ought to be at three-month span [48] dependent on the rhizosphere population of the bioagents. Apply 200g Phosphobacteria and 200 g *Azotobacter* blended in with 50kg of FYM/palm was also effective.

Chemical Management:

Among the few synthetic substances gone after for the control of the infection, Bordeaux combination [49], Heptachlor residue and Copper oxychloride alongside BHC controlled the disease to a specific degree whenever applied in before phases of contamination [13]. Application of Sulphur dust inside the channel, Soil soaking with Bordeaux blend 1% @ 40lit/tree, Trunk infusion/root taking care of with Calixin 3ml/tree are also effective against the disease [50]. Soil soaking with 0.1% IBP, carboxin, tridemorph or 0.05% carbendazim in the mix with 5 kg neem cake for each palm decreased disease power.

REISHI MUSHROOM AS SALUTARY:**Medical advantages of Reishi Mushroom**

Restorative employments of *G. lucidum* in ancient Far East nations incorporated the treatment of neurasthenia, weakness from delayed disease, a sleeping disorder, anorexia, dazedness, ongoing hepatitis, hypercholesterolemia, mushroom harming (antitoxin), coronary heart illness, hypertension, avoidance of elevation infection [51].

A) Regulation of immune system:

Ganoderma lucidum contains a high grouping of Organic Germanium, Polysaccharides and Triterpenes [52]. These dynamic segments are demonstrated to fortify our immunity cells and improve our resistant system. Influencing white blood genes to expand the creation of white blood cells. Expanding T cell and B cell checks to fortify cell-intervened resistance and improve immunizer response. Actuating interleukin quality articulation to manage invulnerable reactions.

B) Nerves:

Reishi mushrooms have been generally suggested by Chinese and Japanese botanists for a sleeping disorder due to their "rest promoting component". Reishi mushrooms are recommended in China for various mental and neurological burdens, including infections including the muscles, anorexia and weakness following extensive illnesses[53]. The dried "mycelium" of Reishi*i.e.*, the root-like body that produces mushrooms has been discovered to be exceptionally successful in the treatment of anxieties brought about by "environmental stress".

C) Anti-Inflammatory Activity or reduction in inflammation:

At the point when a physical issue happens or microorganisms attack, the body conveys a multitude of resistant cells to address the issue [54]. The subsequent fiery course can cause manifestations like pain, swelling and redness. At the point when it doesn't, a chronic inflammatory response creates. The subsequent harm seems to assume a part in chronic and age-related conditions. Many studies demonstrated that Reishi mushroom discretely essentially restrained each of the four kinds of hypersensitive responses including constructive outcomes against asthma and contact dermatitis and successfully utilized in treating stiff necks, firm shoulders, conjunctivitis bronchitis, ailment and improving "ability" of the safe immune system with no critical results [55].

D) Encourages cardiac health:

Reishi may decidedly influence blood lipid levels, even though outcomes may contrast for individuals with other persistent conditions like diabetes [56]. Cell reinforcement action could diminish or forestall lipid peroxidation, which is the initial phase in plaque development. Some proof shows these mushrooms may likewise offer extra advantages by bringing down LDL (low-density lipoproteins) [57] and all-out cholesterol levels, lessening fatty substance creation and expanding HDL (high-density lipoproteins)[58].Consumption of Reishi mushrooms having well impact upon blood pressure.

E) Helps to prevent liver damage:

Reishi mushroom is utilized for the treatment of persistent hepatitis and also has been accounted for to be viable in treating patients with liver failure [59]. Research here shows likely advantages in individuals experiencing liver wounds or hepatitis B, conceivably because of beneficial outcomes on the resistant reaction. Reishi mushroom may likewise repress cells that assume key parts in liver fibrosis [60]. Hot water and water-ether concentrates of the natural product assortment of *G. lucidum* were found to have a strong hepatoprotective impact on liver injury incited by carbon tetrachloride (CCl₄) [61]. The deliberate markers for the liver are included aspartate and alanine transaminases (AST and ALT) and lactate dehydrogenase (LDH). One dynamic compound of the concentrate was isolated and distinguished as ganoderenic acid [62].

F) Anti-cancerous property:

G. lucidum is a famous enhancement taken by the sound individual to support the immune system. Cancer growth patients alongside conventional therapies Studies of Reishi demonstrated to have an enemy of tumour impact [63]. The dynamic enemy of cancer growth constituents in Reishi are called Beta-D-glucan. Beta-D-glucan is a polysaccharide [64]. Regulation of expression of various signs, tumour

cells were captured by *G. lucidum* at various purposes of the cell cycle [65]. Cell grip, invasion, and migration are the critical factors in deciding the forcefulness of disease; subsequently, control of cell motility is effective in maintaining a strategic distance from cancer metastasis. Polysaccharide concentrates of *G. lucidum* mycelia restrained the development of oncogenic [66, 67].

CONCLUSION

Reishi mushroom (*Ganoderma* spp.) is the unbelievable wizard of all prevalent restorative spices because of its evident clinical viability and absence of unfavourable side-effects. It also produces toxins which are used for consumption. On account of its extraordinariness in nature, Reishi mushroom was saved fundamentally for Asian eminence and well-off people until the late twentieth century, after this their cultivation started. On the other hand, Basal stem decay brought about by *G. lucidum* is the most damaging disease of coconut in India. The management of soil-borne microorganisms is unpredictable because the disease happens in a unique climate at the interface of the root with the soil. It causes severe damage to the coconut plant. From all the above information it concludes that Reishi mushroom is a mysterious mushroom and also have numerous appreciable benefits along with devastating character.

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REVIEW ARTICLE

Ganoderma lucidum: As Calamitous and Salutory Mushroom

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ABSTRACT

Ganoderma lucidum, an oriental fungus commonly called as Reishi mushroom, has a long history of traditional use for promoting health and longevity in China, Japan, and other Asian countries. It is an excellent medicinal mushroom even then it is also the causal organism of one lethal disease of coconut known as basal stem rot, foot rot and *Ganoderma* wilt, which was first reported in the country in Thanjavur in Tamil Nadu in 1952, has since been reported in Karnataka, Andhra Pradesh, Gujarat and in various places in Kerala. Apart from the devastating effect on coconut plant, it has some very useful medicinal benefits. Research on this mushroom has shown that polysaccharides and tri-terpenoids are the major active ingredients triggering the human immune system. Recent pharmacological and clinical studies suggest that this mushroom is a blood-thinner and exhibits anti-cancer/anti-tumour effects. It is also effective against Hepatitis - B and lowers blood glucose and blood pressure. Both beneficial as well as deleterious characteristics of *Ganoderma lucidum* summarized in the present review article.

Key words: *Ganoderma lucidum*, Medicinal importance, Reishi mushroom, Stem bleeding, Tanjore wilt

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INTRODUCTION

Reishi is a basidiomycete, lamella less [1] parasite having a place with the group of Polyporaceae [2, 3]. Reishi (*Ganoderma lucidum*) otherwise called "lingzhi" in china and "mannetake" (the mushroom of immortality) in japan [4, 5]. The name lingzhi represents the mix of spiritual potency and essence of immortality in Chinese. It is viewed as the "herb of profound strength" [6] representing achievement, prosperity, divine force, and life span. It is red-stained, kidney-moulded cap and incidentally, embedded stem gives it a distinctive fan-like appearance [7, 8]. It is generally found in wooded mountainous regions where the moisture level in atmosphere is high and dim lighting. It is rarely found because it thrives on dried trunks of dead plum, guercus serrata or pasonia trees [2]. In fact, the development of Reishi mushroom out of 10,000 matured trees is 2-3 only. This value is almost negligible. Reishi mushroom is also known as "mysterious mushroom" because on one side it has some good medicinal properties but on other hand, it causes the most devastating disease of a coconut known as "Thanjavur wilt" [9-10]. In India, coconut (*Cocos nucifera L.*) is a substantial crop [11]. Coconut can be utilized for many purposes such as nutritious beverages, several nutritious items like oil for edible and non-edible uses and fibres for commercial uses and modern employments, for example, an assortment of random items for utilizing like crafted work etc [12]. In India, the reduction in production of coconuts and loss of palms occurs due to Tanjore diseases [13]. Coconut palm is affected by several diseases even though it is solid in nature and adaptable to different harsh weather conditions [10, 14]. Basal stem rot is one of the most destructive diseases among them [15] accounting for severe yield loss in southern parts of India. This disease is also known as *Ganoderma* wilt (Andhra Pradesh) or Thanjavur wilt (Tamil Nadu) or Bole rot or anabe roga (Karnataka) in different parts of India [16]. Butler, firstly reported this disease in palms [17, 18]. This disease has a symptom of yellowing and drooping of leaves followed by exudation of reddish-brown fluid through cracks at the base of the trunk and oozing spread [19-20]. Rotting of tissues at draining point and decaying of the basal part of the stem the bark turns fragile and frequently gets stripped off in pieces, leaving open breaks and cleft. The inner tissues are colourless, disintegrated and discharging a bad

odour. Section formation at the base of the trunk occurs during the rainy season [21]. Eventually, the palm dies off. Reishi mushroom is generally found on the trunk of the coconut plant.

Apart from the devastating effect on coconut plant, it has some very useful medicinal benefits. Reishi, *Ganoderma spp.*, has been known in Japan, China, and different nations as a food and unpolished material for the improvement of medications. Even though the fruiting assortment of *G. lucidum* has been utilized as a conventional home-grown medication since old occasions, the spores came to be used uniquely in the late twentieth century [22]. The spores contained bioactive substances, essentially lanostane-type triterpenes [23] and polysaccharide [24] like those in the fruiting body [25]. Ongoing investigations have demonstrated that the carcinostatic substance in Reishi is a polysaccharide, β -(1—3)-D-glucan. This polysaccharide appears to have assurance as another novel type of carcinostatic agent which may be helpful in immunotherapy. its impact depends on the advancement of the host's immune system. Dissimilar to general carcinostatic specialists it gives off an impression of being nontoxic. Reishi additionally appears to contain different substances which diminish circulatory strain, blood cholesterol, and glucose levels; and repress platelet accumulation, etc [26]. The fame of taking *G. lucidum* as an alternative medication has been expanding in cancer patients [27].

REISHI MUSHROOM

Ganoderma lucidum (commonly known as Reishi mushroom and Lingzhi) has been a financially significant species, especially in the Far East nations for more than 4000 years [28]. It is generally become on a business scale and is regularly bought for its curative and thoughtful properties. Around the world, more than 250 *Ganoderma* species have been shown. Be that as it may, in restorative practices and writing references, *Ganoderma* normally indicates the types of *G. lucidum*. Other than being valued for its therapeutic incentive in China for more than the 1000 year, the absence of accessibility of *G. lucidum* was additionally to a great extent liable for it being so profoundly valued and costly. This yearly mushroom develops on a wide range of dead or failing trees, e.g., deciduous trees. It is red-stained, kidney-moulded cap and incidentally, embedded stem gives it a distinctive fan-like appearance [7-8]. It is also known as a shiny mushroom because of its shiny appearance. Newly formed Reishi mushroom gets going white, and the underside holds this tone. However, the conk turns red or orange and builds up a sheen as it develops. It is also known as a shiny mushroom because of its shiny appearance. Truth be told, *Ganoderma* signifies "glossy skin," and also called "stained conk" due to its wet or painted appearance. By the passing of time, the sheen has started fading its colour and give a dull look. Dullness may likewise show late spore discharge; a few spores settle very near the mushroom.



Fig 1: Basal stem rot - bracket formation

Source: https://image.freepik.com/free-photo/lingzhi-mushroom-growing-trees_45334-35.jpg https://agritech.tnau.ac.in/crop_protection/images/coconut_diseases/N1.2.jpg

CALAMITOUS EFFECT OF REISHI MUSHROOM:

Thanjavur Wilt

A) Incidence and Spreading:

In the year of 1913 in India, *Ganoderma lucidum* was first recorded in Karnataka state by Butler [17]. The disease as Thanjavur wilt was first seen in Thanjavur District of Tamil Nadu after the 1952 and 1956 cyclone [13]. Critical damages are done by *Ganoderma lucidum* to coconut and other lasting crops like

areca nut, oil palm, agro-forestry trees and tea, particularly in Asia. Basal stem rot is generally common in seaside sandy soils or sandy topsoil soils where coconut is raised under rainfed conditions and much consideration was not paid for social practices [29-30]. Nonetheless, the infection is not bound to a specific soil type [29]. Studies on the basis of seasonal incidence of the disease found that the incidence of disease was more frequently happened in between the months of March and August. In these months' symptoms like bleeding and number of death palms were more. More number of deaths happen during summer however the various manifestations are available consistently. By and large, palms capitulate to basal stem rot inside a few long periods of the beginning appearance of indications. However, there were some cases in India where unexpected death happens within a half year of the appearance of beginning indications. Once in a while the palms endure the underlying assault and live for various years [13].

B) Symptoms:

The illness creates various indications on roots, stem and crown area of the palm and identification of the infection is regularly mistaken for stem bleeding diseases (Fig 2). Infection manifestations progress gradually, however normally every time infected plant dies at last. Beginning manifestations of Tanjore wilt (*Ganoderma* wilt) start with yellowing and hanging of the external whorl of leaves [31]. This is trailed by exudation of reddish-brown fluid through breaks at the base of the stem and oozing spread upwards. Rotting of tissues at draining point and spoiling of the basal part of the stem the bark turns weak and regularly gets stripped off in pieces, leaving open breaks and hole. The inside tissues are stained, broken down and producing an awful stench. Section development at the base of the trunk during the rainy season. Eventually, the palm ceases to exist.

Root: The pathogen initially taints the root framework and during the beginning phase of contamination no outside infection is visible. At first, a couple of roots get contaminated and rot. Broad spoiling and staining of root framework are a trademark manifestation of the infection [32].

Shoot: From the roots, the disease gradually advances up the stem prompting interior crumbling of cortical and stele tissues. Exudation of reddish coloured gooey liquid from the basal segments of the stem is the main obvious manifestation of the disease in the influenced palm. At that point, the spoiling would have advanced from the bole to the basal segment of the stem [33]. Bleeding on the stem starts at the base and may reach out up to 15 feet in serious cases (Fig 1 & 2).

Crown: The pamphlets display shrivelling manifestations and a couple of external whorls of leaves turn yellow [34]. Afterwards, the display light to moderate browning followed by hanging and drying. As the disease propels, the excess leaves additionally hang down one after another and the axle alone remains. As the disease advances, number of blossoms, number of catches diminishes and ordinary improvement is captured prompting button shedding. The leaves hang down bringing about hanging down of the subtended bundles. Palms matured 10 years and more established were more helpless to the disease than youthful palms.



Fig 2: Stem Bleeding of Coconut due to Tanjore Wilt

Source: https://agritech.tnau.ac.in/crop_protection/coconut_diseases_1.html

C) Etiology:

The genus *Ganoderma* has a place with the family Ganodermataceae of Basidiomycota which causes white decays in numerous woody plants by decaying lignin as well as cellulose and related polysaccharides [35]. The elevated mycelium of *Ganoderma* is hyaline, dainty walled, stretched with incessant clip associations, richly formed chlamydospores which are marginally thick-walled, terminal or intercalary, ellipsoid and some of the time in chains [36]. Cuticular cells from crustose layer are hyaline to light brown, round to irregular in shape and firmly stuffed [33]. The fruiting body is lasting, stipitate,

ordinarily sidelong, at times sessile, corky turning out to be woody later. The palisade hyphae are about 40 μ m long and are impregnated with a dim orange staining substance which they emit [Fig 3(a)]. The hymenial surface is whitish or on the other hand, creamy and turning earthy coloured later, little pores. Pore tubes are around 6-7 mm long, basidiospores [fig 3(b)] are earthy coloured, thick-walled, minutely wartlike [35].

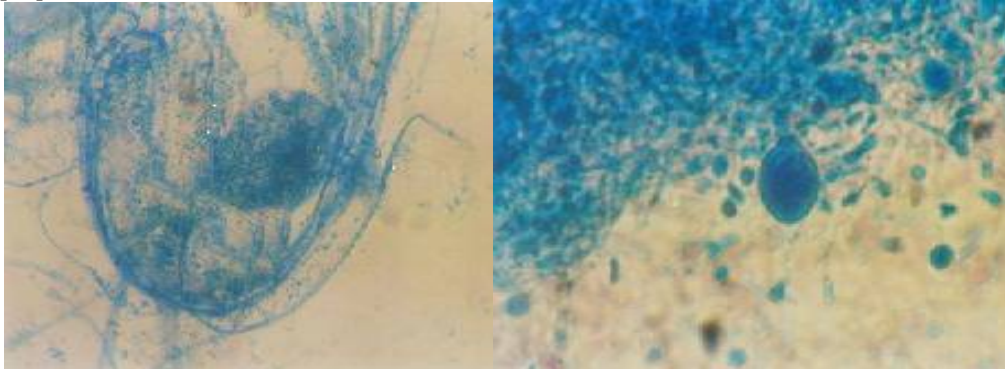


Fig 3: (a) Hyphae of *Ganoderma*; (b) Spores of *Ganoderma*[37]

D) Epidemiology:

Basal stem rot disease is a deadly disease influencing youthful and effectively bearing trees and recuperation is very rare after disease infection [13]. By and large, palms matured previously 15 years alone are contaminated with basal stem rot disease. The disease is generally common in sandy soils and where coconut gardens are raised under rainfed conditions [33]. Lack of soil dampness during late spring months, presence of old tainted stumps in the nursery, injury to roots and non-selection of suggested social practices supported the disease spread [38, 39]. Soil dampness stress experienced during mid-year months was found to support the spread of the disease. Role of climate factors, for example, temperature, downpour fall, blustery days, relative dampness on infection advancement was studied. Ramapandu *et al.* (1981) revealed that illness spread was more when the scope of distinction in relative humidity was higher and precipitation was lesser [40].

E) Disease Management

The infection is considered generally dangerous as it gets away from early indications and having different safe stages, for example, safe mycelium, chlamydospores, basidiospores and pseudosclerotia. Different trials are going on in the country for infection opposition and to discover successful administration measures[41]. None of the germplasm screened against the infection appeared protection from the disease. A few management trials were conducted utilizing nutritional, social, organic and chemical compound measures against the infection[40]. In any case, consequences of the infection the board trials depend on soil condition, age of the crop, phase of disease advancement and climate boundaries of that specific territory.

Cultural Management

Different social furthermore, wholesome administration measures were read for containing seriousness of the infection[42]. The strategies incorporate digging isolation trenches, evacuation and burning of dead contaminated plant material, abstaining from furrowing and flood water system, developing intercrops etc. [43]. Destruction of dead and rotted plant material was recommended by numerous specialists [44].

Biological Management

Antagonistic microorganisms, for example, *Trichoderma* species, *Pseudomonas fluorescens*, *Bacillus subtilis* are announced against *Ganoderma spp.* in India [45]. Application of 5 to 10 kg neem cake for every palm every year empowered saprophytic soil microflora particularly *Trichoderma* in coconut basins and was successful in the control of Basal stem rot. Application of 50 g of *Trichoderma viride*[46] alongside 5 kg of neem cake per palm every year controlled the straight spread of Basal stem rot inside a time of four months. *Pseudomonas fluorescens* was accounted for to have opposing action against *Ganoderma spp.* [47] under *in vitro* conditions. Frequency of use of bioagents ought to be at three-month span [48] dependent on the rhizosphere population of the bioagents. Apply 200g Phosphobacteria and 200 g *Azotobactor* blended in with 50kg of FYM/palm was also effective.

Chemical Management:

Among the few synthetic substances gone after for the control of the infection, Bordeaux combination [49], Heptachlor residue and Copper oxychloride alongside BHC controlled the disease to a specific degree whenever applied in before phases of contamination [13]. Application of Sulphur dust inside the channel, Soil soaking with Bordeaux blend 1% @ 40lit/tree, Trunk infusion/root taking care of with Calixin 3ml/tree are also effective against the disease [50]. Soil soaking with 0.1% IBP, carboxin, tridemorph or 0.05% carbendazim in the mix with 5 kg neem cake for each palm decreased disease power.

REISHI MUSHROOM AS SALUTARY:**Medical advantages of Reishi Mushroom**

Restorative employments of *G. lucidum* in ancient Far East nations incorporated the treatment of neurasthenia, weakness from delayed disease, a sleeping disorder, anorexia, dazedness, ongoing hepatitis, hypercholesterolemia, mushroom harming (antitoxin), coronary heart illness, hypertension, avoidance of elevation infection [51].

A) Regulation of immune system:

Ganoderma lucidum contains a high grouping of Organic Germanium, Polysaccharides and Triterpenes [52]. These dynamic segments are demonstrated to fortify our immunity cells and improve our resistant system. Influencing white blood genes to expand the creation of white blood cells. Expanding T cell and B cell checks to fortify cell-intervened resistance and improve immunizer response. Actuating interleukin quality articulation to manage invulnerable reactions.

B) Nerves:

Reishi mushrooms have been generally suggested by Chinese and Japanese botanists for a sleeping disorder due to their "rest promoting component". Reishi mushrooms are recommended in China for various mental and neurological burdens, including infections including the muscles, anorexia and weakness following extensive illnesses[53]. The dried "mycelium" of Reishi*i.e.*, the root-like body that produces mushrooms has been discovered to be exceptionally successful in the treatment of anxieties brought about by "environmental stress".

C) Anti-Inflammatory Activity or reduction in inflammation:

At the point when a physical issue happens or microorganisms attack, the body conveys a multitude of resistant cells to address the issue [54]. The subsequent fiery course can cause manifestations like pain, swelling and redness. At the point when it doesn't, a chronic inflammatory response creates. The subsequent harm seems to assume a part in chronic and age-related conditions. Many studies demonstrated that Reishi mushroom discretely essentially restrained each of the four kinds of hypersensitive responses including constructive outcomes against asthma and contact dermatitis and successfully utilized in treating stiff necks, firm shoulders, conjunctivitis bronchitis, ailment and improving "ability" of the safe immune system with no critical results [55].

D) Encourages cardiac health:

Reishi may decidedly influence blood lipid levels, even though outcomes may contrast for individuals with other persistent conditions like diabetes [56]. Cell reinforcement action could diminish or forestall lipid peroxidation, which is the initial phase in plaque development. Some proof shows these mushrooms may likewise offer extra advantages by bringing down LDL (low-density lipoproteins) [57] and all-out cholesterol levels, lessening fatty substance creation and expanding HDL (high-density lipoproteins)[58].Consumption of Reishi mushrooms having well impact upon blood pressure.

E) Helps to prevent liver damage:

Reishi mushroom is utilized for the treatment of persistent hepatitis and also has been accounted for to be viable in treating patients with liver failure [59]. Research here shows likely advantages in individuals experiencing liver wounds or hepatitis B, conceivably because of beneficial outcomes on the resistant reaction. Reishi mushroom may likewise repress cells that assume key parts in liver fibrosis [60]. Hot water and water-ether concentrates of the natural product assortment of *G. lucidum* were found to have a strong hepatoprotective impact on liver injury incited by carbon tetrachloride (CCl₄) [61]. The deliberate markers for the liver are included aspartate and alanine transaminases (AST and ALT) and lactate dehydrogenase (LDH). One dynamic compound of the concentrate was isolated and distinguished as ganoderenic acid [62].

F) Anti-cancerous property:

G. lucidum is a famous enhancement taken by the sound individual to support the immune system. Cancer growth patients alongside conventional therapies Studies of Reishi demonstrated to have an enemy of tumour impact [63]. The dynamic enemy of cancer growth constituents in Reishi are called Beta-D-glucan. Beta-D-glucan is a polysaccharide [64]. Regulation of expression of various signs, tumour

cells were captured by *G. lucidum* at various purposes of the cell cycle [65]. Cell grip, invasion, and migration are the critical factors in deciding the forcefulness of disease; subsequently, control of cell motility is effective in maintaining a strategic distance from cancer metastasis. Polysaccharide concentrates of *G. lucidum* mycelia restrained the development of oncogenic [66, 67].

CONCLUSION

Reishi mushroom (*Ganoderma* spp.) is the unbelievable wizard of all prevalent restorative spices because of its evident clinical viability and absence of unfavourable side-effects. It also produces toxins which are used for consumption. On account of its extraordinariness in nature, Reishi mushroom was saved fundamentally for Asian eminence and well-off people until the late twentieth century, after this their cultivation started. On the other hand, Basal stem decay brought about by *G. lucidum* is the most damaging disease of coconut in India. The management of soil-borne microorganisms is unpredictable because the disease happens in a unique climate at the interface of the root with the soil. It causes severe damage to the coconut plant. From all the above information it concludes that Reishi mushroom is a mysterious mushroom and also have numerous appreciable benefits along with devastating character.

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