FIELD GUIDE TO FOREST DISEASES OF NEPAL

Government of Nepal
Ministry of Forests and Environment
Forest Research and Training Centre
Babarmahal, Kathmandu

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Foreword

Forests are important ecological assets that sustain biodiversity, regulate climate, and deliver essential ecosystem services. Forest ecosystems are integral to the livelihoods of millions and contribute significantly to the environmental stability and socio-economic development in Nepal. However, the vitality and resilience of these ecosystems are increasingly threatened by a range of biotic stressors, among which forest tree diseases are of increasingly serious concerns.

This field guide, Important Diseases of Forest Trees in Nepal, has been prepared as part of the Forest Health Project (TCP/3702/NEP), implemented by the Forest Research and Training Centre and technical and financial support provided by the Food and Agriculture Organization (FAO) of the United Nations. The guide is based on data produced through systematic field surveys conducted in both natural and planted forests across selected regions of Nepal. It documents key forest tree diseases, their symptoms, and the causative pathogens identified through field observation and laboratory analysis.

Despite limitations such as the short duration of fieldwork and the inability to apply Koch's postulates in most cases due to time and resource constraints, this guide offers a scientifically credible and practical resource for the early detection and response to forest diseases. It is intended to support forestry professionals, researchers, students, and community-level stakeholders in improving forest disease diagnostics and management practices. Preparation of this guide marks a critical step towards institutionalizing forest health monitoring in Nepal. While it does not claim to provide an exhaustive inventory of all existing forest diseases, it lays the foundation for further research, capacity building, and collaborative action to safeguard the health of Nepal's forest resources.

I extend my sincere gratitude to former Director Generals of the FRTC, Yam Prasad Pokharel and Meghnath Kafle, for their invaluable leadership and guidance. I also deeply appreciate the

technical expertise, essential resources, and generous support provided by the FAO and the Kerala Forest Research Institute, India, which were instrumental in the successful implementation of the TCP project. Simultaneously, I sincerely thank Drs. Binod Saha, Shiroma Sathyapala, K.V. Sankaran, Illias Animon, T.V. Sajeev, S. S. Sandeep, Sanjay Jha, Ripu Kunwar, as well as Shrawan Adhikari and Shambhu Charmakar for their technical support and invaluable facilitation throughout the course of the project. I extend my deepest gratitude to Dhirendra Kumar Pradhan (then DDG), Ms. Sunita Ulak, Surendra Adhikari, Dipesh Sharma, Kiran Kumar Pokharel, and Keshav Ghimire for their invaluable contributions to the successful implementation of the project and the preparation of this field guide. Their dedicated efforts in field coordination, systematic data collection, and thorough technical review have greatly enhanced the quality, accuracy, and practical utility of this field guide.

With heartfelt appreciation, I extend my sincere thanks to Deputy Director Generals Rabindra Maharjan, Rajendra Kumar Basukala, and Dr. Rajesh Malla, as well as Under Secretaries Bimal Kumar Acharya, Thakur Subedi, Raj Kumar Giri, Milan Dhungana, Sushil Bhandari, Kanchan Kumar Nayak, and the entire FRTC team. I would also like to offer special thanks to Tika Ram Prajuli (Account Officer) and Netra Aryal (Admin cum Storekeeper) for their procedural support and steadfast backup. Their collective coordination and collaboration were essential to the success of this initiative.

I applaud the technical team for their dedication in preparing this guide and encourage all stakeholders to make full use of this resource in the field. I also urge relevant institutions and partners to continue their support for research and monitoring initiatives aimed at the treatment of forest diseases and their sustainable management.

Rajendra K.C., PhD
Director General

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Introduction

Invasion by alien species (IAS)severely impact native biodiversity and ecosystem function in all ecosystems across the globe. The extent of damage due to IAS is difficult to assess and it is more so in the case of invasive alien plant pathogens due to the lack of knowledge on the mode of pathogenesis (Picco *et al*., 2011). The introduction of invasive pathogens is mainly through inter and intra-continental travel and transport of goods and their range expansion is helped by land use and climate change and the emergence of novel pathogens mainly through evolution and hybridization.

Invasion by alien pathogens is known to negatively impact the productivity, sustainability, and ecosystem function of many forests and they can also alter forest succession and species composition. The damages due to these species have been more severe, widespread and long-term and hence difficult to mitigate compared to the damages caused by other biological agents.

In the above context, Pysek *et al*. (2008) expressed serious concern as invasion ecology has paid very limited attention to fungi which are usually poorly, if at all, represented in alien species databases. Fungi hardly represent 5% of the species listed in the Global Invasive Species Database (GISD) (http://www.issg.org/database/welcome/). A detailed study on this important group of eukaryotes is highly necessary since it is a hugely diverse group but less studied compared to animals and plants. Lack of knowledge of the fungal communities (Desprez-Loustau *et al*., 2007) and limited information on their systematics, geographical

range and time of introduction (Pascal *et al*., 2006) frustrates inclusion fungi in the GISD.

Against this background, this Field Guide provides preliminary information on the occurrence of fungal pathogens on trees in natural and planted forests in Nepal. The information provided was based on a short-term survey for fungal pathogens in these ecosystems. Attention has been paid to identify invasive alien pathogens which may need special consideration for management. However, it needs to be mentioned here that this study forms only a first step towards understanding the diversity of fungal pathogens of forest trees in Nepal. More intensive and long-term studies are warranted to assess the problem in more detail and implement suitable management measures.

Reference:

Desprez-Loustau M.L., Robin C., Bue´e M., Courtecuisse R., Garbaye J., Suffert F., Sache I. and Rizzo D. (2007). The fungal dimension of biological invasions. Trends EcolEvol 22:472–480.

Pascal M., Lorvelec O. and Vigne J.D. (2006). Invasions biologiques et extinctions—11000 ansd'histoire des verte´bre´sen France. Quae and Belin, Paris.

Picco A.M., Angelini P., Ciccarone C., Franceschini A., Ragazzi A., Rodolfi M., Varese G.C. and Zotti M. (2011). Biodiversity of emerging pathogenic and invasive fungi in plants, animals and humans in Italy. Plant Biosystems145(4): 988-996.

Pysek P., Richardson D.M., Pergl J., Jarosik V., Sixtova Z. and Weber E. (2008). Geographical and taxonomic biases in invasion ecology. Trends EcolEvol 23:237–244.

Aureobasidium apocryptum (Ellis & Everh.) Herm. -Nijh.

Leaf anthracnose on *Acer laevigatum*

Synonyms:

Gloeosporium apocryptum Ellis & Everh.; *Kabatiella apocrypta* (Ellis & Everh.) Arx

Phylum: Ascomycota | **Class:** Dothidiomycetes

Order: Incertae | **Family:** Dothioraceae

Common name: *Aureobasidium* Leaf anthracnose

Disease: Leaf anthracnose

Host: *Acer laevigatum* Wall.

Distribution: World wide; first record in Nepal.

Altitude of collection site: 2642m.

Disease symptoms:

Early symptoms are indefinite light brown spots on the leaves. Damage is characterized by the development of large areas of dead tissue on host leaves. Severe infection covers the entire leaf and the petiole of young twigs.

Possible dispersal:

Spores formed in the acervuli are spread by rain splashes to newly emerging leaves. Infection mainly occurs during wet periods leading to formation of necrotic spots.

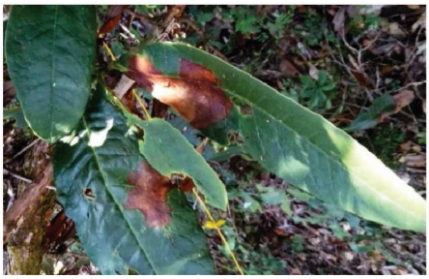
Impact: The disease reduces the productivity of trees. High mortality of host, if the infection is severe.

Management: Remove and dispose of infected leaves. Use of protective fungicides is very useful.

Status: Invasive alien pathogen

Reference: Frank SD, Klingeman WE, White SA, Fulcher A. 2013. Biology, injury, and management of maple tree pests in nurseries and urban landscapes. Journal of Integrated Pest Management, 4(1), B1-B14.

Calonectria indusiata (Seaver) Crous



Leaf blight on *Rhododendron arboreum*

Synonyms:
Calonectria theae Loos

Phylum: Ascomycota | **Class:** Sordariomycetes

Order: Hypocreales | **Family:** Nectriaceae

Common name: Calonectria leaf blight

Disease: Leaf spot/blight

Host: *Rhododendron arboreum* Sm.

Distribution: World-wide; first report from Nepal.

Altitude of collection site: 2201m.

Disease symptoms:

Diseased plants show dark brown leaf spots that enlarge, coalesce and result in defoliation. Symptoms developed most explicitly on this species during May/June with hot and humid climate.

Possible dispersal: Wind-dispersed.

Impact: Infection causes serious impact on plants in terms of productivity.

Management: Removal of infected leaves is useful in the early stage of infection. Use of suitable fungicides is very effective.

Status: Invasive alien pathogen

Reference: Inghelbrecht S, Gehesquière B, Heungens K. 2011. First report of Calonectria leaf spot caused by *Calonectria colhounii* (anamorph *Cylindrocladium colhounii*) on *Rhododendron* in Belgium. Plant disease, 95(11), 1477-1477.

Calonectria reteaudii (Bugnic.) C. Booth

Leaf blightof *Eucalyptus camaldulensis*

Synonym:
Calonectria pyrochroa (Desm.) Sacc.

Anamorph:
Cylindrocladium reteaudii(Bugn.) Boesew.

Phylum: Ascomycota | **Class:** Sordariomycetes

Order: Hypocreales | **Family:** Nectriaceae

Common name: Blight

Disease: Leaf blight

Host:

Eucalyptus camaldulensis Dehnh.

Distribution: World-wide; occurs in west Nepal (Dang) and central Nepal (Sarlahi, Sagarnathplanted forest)

Altitude of collection site:200-600 m.

Disease symptoms:

Initially greyish water-soaked spots which coalesce into extensive necrotic areas; leaves dry out, defoliate from base upwards leading to total defoliation and tree death.

Possible dispersal:

High humidity and rainfall favours infection. Spores are dispersed via water, wind, soil or cultural practices. Micro-sclerotia help to overcome harsh climatic conditions and unfavourable soil pH.

Impact: High mortality of trees, if the infection is severe.

Management: Good sanitation practices if the disease occurs in nursery; severely affected plants should be removed promptly. Application of a Copper fungicides are very effective for calonectria. to control the disease, if not widespread.

Status: Invasive alien pathogen

Reference: Rodas CA, Lombard L, Gryzenhoinf M, Slippers B, Wingfield, MJ. 2005. *Cylindrocladium* blight of *Eucalyptus grandis* in Colombia. Australasian Plant

Dothistroma septosporum (Dorog.) M. Morelet

Needleblight of *Pinus roxburghii*

Synonym:
Mycosphaerella pini Rostr.

Phylum: Ascomycota | **Class:** Dothideomycetes

Order: Capnodiales | **Family:** Mycosphaerellaceae

Common name: Needle blight

Disease: Pinus needle blight

Host:

Pinus roxburghii Sarg.

Distribution: World-wide; occurs incentral Nepal (Lamjung)

Altitude of collection site: 1400 m.

Disease symptoms:

Yellowish-tan spots on needles which turn brownish or reddish-brown with age and produce a red band around the needle. Small black fruiting bodies appear in the centre of the red band. Infected needles die and drop prematurely. The lower crown of affected trees turns red in colour.

Possible dispersal:

Through wind, water splashes and infected planting stocks. Mild climate with high rainfall, fog or mist favour infection. Optimum temperature for spore germination is 18-24°C.

Impact: Loss in wood volume and ultimate tree mortality if the infection is severe. The pathogen has significant impact on Christmas tree plantations, commercial forests and in nurseries.

Management: Application of copper-based fungicides. Planting resistant planting stocks will be useful.

Status: Invasive alien pathogen

Reference: Barnes I, Crous PW, Wingfield BD, Wingfield MJ. 2004. Multigene phylogenies reveal that red band needle blight of *Pinus* is caused by two distinct species of *Dothistroma*, *D. septosporum* and *D. pini*. Studies in Mycology, 50(2), 551-565.

Golovinomyces cichoracearum (DC.) V.P. Heluta

Powdery mildew on *Alnus nepalensis*

Synonym:
Erysiphe cichoracearum DC.

Phylum: Ascomycota | **Class:** Leotiomycetes

Order: Erysiphales | **Family:** Erysiphaceae

Common name: Powdery mildew

Disease: Powdery mildew

Host: *Alnus nepalensis* D.Don

Distribution: World-wide, occurs in central Nepal (Lamjung- Alnus Forest (CF) and western Nepal (Dadeldhura, Ugratara temple)

Altitude of collection site: 900 m.

Disease symptoms:

White powdery spores on both sides of leaves; leaves turn yellow, brown or show chlorosis and drop prematurely.

Possible dispersal:

Through cleistothecia which remains dormant until optimum conditions (*temperature 25-30°C, humidity 80-90%).*

Impact: Lower growth rate compared to healthy plants; mortality of seedlings if the infection is severe.

Management: Good sanitation practices, removal of severely affected plants. Drenching with 0.3% wettable sulphur is useful.

Status: New record on *Alnus nepalensis* in Nepal

Reference: Mieslerová B, Sedlářová M, Michutová M, Petřeková V, Cook R, Lebeda A. 2020. Powdery Mildews on Trees and Shrubs in Botanical Gardens, Parks and Urban Green Areas in the Czech Republic. Forests, 11(9), 967.

Ganoderma sp.

Ganoderma basal stem rot

Phylum: Basidiomycota | **Class:** Agaricomycetes

Order: Polyporales | **Family:** Ganodermataceae

Common names: Butt rot, basal stem rot, wood decay

Disease: Butt rot

Host:

Quercus semecarpifolia Sm.

Distribution: World-wide, occurs in west Nepal (Dadeldhura)

Altitude of collection site: 1000-1200m.

Disease symptoms:

Mild to severe wilting affecting the canopy. Bark at collar region gets rotted turn brown and often splits. Roots become dark brown to black. Branches wither top to downwards. Basidiocarps of the fungus found at the base of the tree aid to confirm the disease.

Possible dispersal:

Through transport of infected plant parts carrying hyphae, spores and /or fruiting bodies. Soils with poor drainage and water stagnation during rainy season also favour the disease.

Impact: Tree mortality

Management: Cultural practices; use of resistant varieties; integrated disease management. Nochemical control measures are known.

Status: Common white rot pathogen (Found in western mid mountain and siwalik regions (Surkhet) causing but rot in *Shorea robusta* as well as in the lower temperate region in *Quercus semecarpifolia).*

Reference: Phillips DH, Burdekin DA. 1992. Diseases of oak (*Quercus* spp.). In Diseases of forest and ornamental trees(pp. 241-258). Palgrave Macmillan, London.

Nectria sp.

Nectria stem canker on *Shorea robusta*

Phylum: Ascomycota | **Class:** Sordariomycetes

Order: Hypocreales | **Family:** Nectriaceae

Common name: Nectria stem canker

Disease: Stem canker

Host: *Shorea robusta* Roth

Distribution: First report from Nepal

Altitude of collection site: 424m.

Disease symptoms:

Nectria canker may occur throughout the year. The first visible symptoms appear in spring. Cankers are usually oval to elongate but can vary in size and shape. Typically, they appear as localized sunken, slightly discoloured, brown to reddish lesions on the bark of trunk and branches, or as injured areas on smaller twigs. The bark often splits from diseased part and may ooze sap or moisture. The inner part turns black and sometimes gives off a foul odour.

Possible dispersal:

Fruiting bodies release spores that are dispersed by air currents or rain, and invade susceptible trees and cause infection.

Impact: Nectria canker is a serious disease but it seldom kills the host. Cankered branches are prone to breakage, which can distort the host plant, and stunt its growth. The incidence of cankering tends to be greater in areas where heavy snow and ice storms are common. The combination of diseases often causes the host to decline rapidly.

Management: Maintain plant vigour through sound cultural practices. Prune and dispose of branches with cankers during dry periods. Minimize wounding through pruning and other activities such as transplanting to reduce the number of potential infection sites.

Status: Invasive alien pathogen

Reference: Verma RK, Sharma N, Soni KK. 2008. Forest Fungi of Central India. International Book Distributing Company, Lucknow, India, 418 pp.

Neonectria neomacrospora (C. Booth & Samuels) Mantiri& Samuels

Abies spectabilis showing needle cast symptoms

Anmorph:
Cylindrocarpon cylindroides Wollenweber

Phylum: Ascomycota | **Class:** Soradariomycetes

Order: Hypocreales | **Family:** Nectriaceae

Common names: Needle cast

Disease: Needle cast

Host:

Abies spectabilis (D.Don) Spach

Distribution: Wordwide, first report from eastern Nepal (Taplejung-MayamPatalC.F)

Altitude of collection site: 3400m.

Disease symptoms:

Discoloration of needles and needle drop. Infected needles turn brown in early stages and turn dark brown before falling. A severely affected tree will have many bare branches. The disease usually attacks the oldest needles on branches in the lower canopy. The disease progresses upwards in the canopy.

Possible dispersal:

Through ascospores which are wind-dispersed. Also, through dissemination of conidia through rain splashes. N. neomacrospora is known to be a seed borne pathogen.

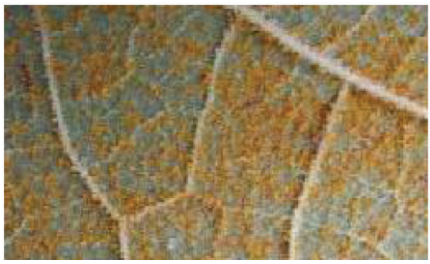
Impact: Reduced growth and high mortality.

Management: Removal of diseased trees; application of fungicides.

Status: Invasive alien pathogen

Reference: Nielsen UB, Xu J, Nielsen KN, Talgø V, Hansen OK, Thomsen IM. 2017. Species variation in susceptibility to the fungus *Neonectria neomacrospora* in the genus *Abies*. Scandinavian Journal of Forest Research, 32(5), 421-431.

Olivea tectonae (T.S. Ramakr. & K. Ramakr.) J.L. Mulder



Rust affected leaf Lower surface of leaf showing uredinia

Synonyms:
Chaconia tectonae T. S. Ramakr. & K. Ramakr.

Phylum: Basidiomycota | **Class:** Pucciniomycetes

Order: Pucciniales | **Family:** Raveneliaceae

Common name: Teak leaf rust

Disease: Leaf rust

Host: *Tectona grandis* L.

Distribution: World-wide; first report from Nepal.

Altitude of collection site: 115m.

Disease symptoms:

Infected leaves will show small angular brown to grey necrotic areas on the upper surface. Large areas of necrosis will be evident where lesions had coalesced. The necrotic areas corresponded to numerous sub-epidermally erumpent uredinia on the lower leaf surface. In severe infection, uredinia and urediniospores cover the entire leaf.

Possible dispersal:

Through wind. Lower temperature and high humidity are crucial for spore germination and dispersal.

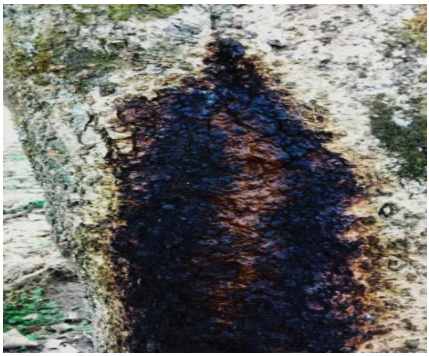
Impact: Infection causes serious impact in young plants in terms of growth, but no serious concern in mature trees.

Management: Use of fungicides in nursery situations and cultural practices like pruning and thinning in young plantations are useful.

Status: Invasive alien pathogen

Reference: Cabral PGC, Capucho AS, Pereira OL, Maciel-Zambolim E, Freitas RL, Zambolim L. 2010. First report of teak leaf rust disease caused by *Olivea tectonae* in Brazil. Australasian Plant Disease Notes, 5(1), 113-114.

Phytophthora alni Brasier & S.A. Kirk



Stem bleeding due to canker on *Alnus nepalensis*

Phylum: Oomycetes | **Class:** Oomycota

Order: Peronosporales | **Family:** Peronosporaceae

Common names: Alder *Phytophthora*

Disease: Bleeding canker

Host: *Alnus nepalensis* D.Don

Distribution: World-wide, occurs in centralNepal(Lamjung- Alnus forest (CF) and western Nepal (Dadeldhura, Ugratara temple)

Altitude of collection site: 1640m.

Disease symptoms:

The infected bark shows reddish-brown fluid oozing from cracks which will dry to a dark, tarry material. The foliage will appear pale and sparse and the branches may start to die above the infected areas. Removal of outer bark over infected areas will reveal a reddish-brown discoloured area on inner bark, with a diffuse edge if the infection is still spreading and a sharply defined edge if it is stable. Healthy inner bark is white or pinkish in colour.

Possible dispersal:

Soil borne pathogen. The disease spreadsthrough the movement of contaminated soil, plant material, tools and equipment. The infection is favoured by warm humid conditions.

Impact: High mortality of trees, if the infection is severe.

Management: Good sanitation practices and removal of severely affected trees. Drenching the soil with suitable fungicides.

Status: Invasive alien pathogen

Reference: Aday Kaya AG, Lehtijärvi, A, Şaşmaz, Y, Nowakowska JA, Oszako T, Doğmuş Lehtijärvi HT, Wood ward S. 2018. *Phytophthora* species detected in the rhizosphere of *Alnus glutinosa* stands in the Floodplain Forests of Western Turkey. Forest Pathology, 48(6), e12470.

Rhytisma acerinum Schwein.

Tar spot on upper surface of *Toona ciliate* leaf Tar spot on lower surface of *Toona ciliate* leaf

Phylum: Ascomycota | **Class:** Leotiomycetes

Order: Rhytismatales | **Family:** Rhytismataceae

Common name: Rhytisma tar spot

Disease: Tar spot

Host: *Toona ciliata* M. Roem.

Distribution: India; first report from Nepal

Altitude of collection site: 183m.

Disease symptoms:

Numerous small, superficial and blackish distinct tar like spots on upper side of leaf. The initial symptoms are yellowish-green spots which develops to form tar spots later. These spots may grow up to 2-4 cm in diameter. A microscopic sign of the pathogen is the stroma and mats of hyphae found on lesions. These lesions cause senescence of leaves.

Possible dispersal:

Through wind; spores have a sticky coat to attach to new healthy leaves.

Impact: Disease affects rate of photosynthesis in leaves.

Management: Removal of leaf litter from site, proper sanitisation, and use of fungicides.

Status: Invasive alien pathogen

Reference: Chandel S, Kumar V. 2017. First report of tar spot of *Toona* (*Toona ciliata*) in India. Journal of Applied and Natural Science,9 (2), 784–785.

Taphrina caerulescens (Desm. & Mont.) Tul.

Leaf blisters on *Engelhardia spicata*

Synonyms:
Ascomyces caerulescens Desm. & Mont.

Phylum: Ascomycota | **Class:** Taphrinomycetes

Order: Taphrinales | **Family:** Taphrinaceae

Common name: *Taphrina* leaf blister

Disease: Leaf blister

Host:
Engelhardia spicata Lesch. ex Blume

Distribution: First report from Nepal

Altitude of collection site: 950m.

Disease symptoms:

Initial symptoms on the leaf are small green to yellow, slightly swollen, convex-concave blisters that vary in size. Eventually the lesions become more pronounced and start to turn brown. The lesions will be approx. 2 cm in diameter and may appear larger if they merge. The leaf shape may also be distorted. In most cases the infected leaves do not drop prematurely from the tree but may be the earliest to drop in the autumn.

Possible dispersal:

Through wind; low temperature and high humidity are crucial for spore germination and dispersal.

Impact: The disease does not cause any serious loss to the host plant.

Management: Watering and fertilizing infected trees can help reduce disease symptoms. Sanitation may help in reducing the inoculum load. Use of fungicides is useful in managing the disease.

Status: Invasive alien pathogen

Reference: Bergdahl AD, Alison, H. 2016. Diseases of trees in the Great Plains. Gen. Tech. Rep. RMRS - GTR -335. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Res. Station. 229 p.