A Preliminary Investigation of Canopy Decline and Thinning of Urban Pepper Trees (*Schinus molle*) in Cochabamba, Bolivia

JAIME G. RIVERO-MORENO

Abstract

The pepper tree (*Schinus molle*), known in Bolivia as "molle", is indigenous and widely distributed in the Cochabamba Valley, Bolivia, as well as in other countries in the Americas, and is widely cultivated around the world in regions with an appropriate climate. Between April and June 2025, a general decline in vigor and loss of foliage was observed in several specimens of this species distributed throughout the metropolitan area of Cochabamba. The signs and symptoms might be attributable to common parasitic species such as the mistletoe (jamillo, *Ligaria cuneifolia*) and harmful insects such as the psyllid *Calophya schini*. Uncommon, harmful insects have also been observed in pepper trees showing decline symptoms, such as the leafhopper *Aethalion reticulatum*, the thorn bug *Enchenopa* sp., and the green leafhopper *Empoasca* cf. *sativae*. However, the most worrisome potential cause of decline is a fungus in the genus *Botryosphaeria*, which causes dieback of new shoots. Studies are recommended to understand the factors influencing pathogen-host distribution and -interaction in order to assess and predict current and future damage, as well as the biological changes that trees experience due to infection.

Resumen

El pimentero (*Schinus molle*), conocido en Bolivia como "molle", es originario y se encuentra ampliamente distribuido en el Valle de Cochabamba, Bolivia, así como en otros países de América y se cultiva ampliamente en regiones con climas favorables en todo el mundo. Entre abril y junio de 2025, se observó una disminución general del vigor y pérdida de follaje en varios ejemplares de esta especie distribuidos en el área metropolitana de Cochabamba. Los signos y síntomas podrían atribuirse a especies parásitas comunes como el muérdago (jamillo, *Ligaria cuneifolia*) e insectos dañinos como el psílido *Calophya schini*. También se han observado insectos dañinos poco comunes en pimenteros que presentan síntomas de decaimiento, como la chicharrita *Aethalion reticulatum*, la chinche espinosa *Enchenopa* sp. y la chicharrita verde *Empoasca* cf. *sativae*. Sin embargo, la causa potencial más preocupante de decaimiento es un hongo del género Botryosphaeria, que causa la muerte regresiva de los brotes nuevos. Se recomiendan estudios para comprender los factores que influyen en la distribución e interacción patógeno-huésped con el fin de evaluar y predecir los daños actuales y futuros, así como los cambios biológicos que experimentan los árboles debido a la infección.

Introduction

The pepper tree (*Schinus molle*) is indigenous to the valleys of Bolivia, including throughout much of Cochabamba from 1,000 to 3,400 m elevation (Rivero and Meave 1998). National Law No. 1278 of October 22, 1991 declared it the symbol tree of the Inter-Andean Valleys of Bolivia (**Fig. 1**)

Between April and June 2025, a general decline in vigor and loss of foliage was noted in several pepper trees throughout the metropolitan area of Cochabamba. This condition was conspicuous because more than 2,000 specimens of this species were observed in 2023 and 2024 during another study (Rivero and Román 2024); thus, the decline of several of these specimens was easily discerned.

Considering the presence of biotic factors, such as insects and fungi, as well as abiotic factors, such as humidity, precipitation, and temperature, it is highly likely that any one of these factors will not act alone, but rather two or more will act in combination. Climate change and its associated effects, such as prolonged consecutive years of drought followed by years of abundant rainfall, could not only stress trees and cause canopy thinning on their own, but could also initiate

1. Healthy and vigorous examples of pepper trees, the iconic tree of the Inter-Andean Valleys of Bolivia, showing healthy, dense foliage throughout the trees canopies.

2. A pepper tree with noticeable foliage damage, making the canopy appear diminished, sparse, and weak.

or predispose trees to diseases and pests. Therefore, vigilance and monitoring are essential to prevent the spread of potential diseases and pests that could endanger the already deteriorated urban trees.

Research Problem Statement

Numerous pepper trees show evident decline and noticeable foliage loss or canopy thinning (**Fig. 2**). The competent authorities have not officially reported any probable or proven cause for this malady.

Objective

The present investigation aims to determine the possible causes of canopy decline and thinning in urban Pepper trees (*Schinus molle*) in the metropolitan area of Cochabamba.

Background Information

Characteristics of the Pepper Tree (*Schinus molle*)

Linnaeus described *Schinus molle* (Anacardiaceae) in 1753 simultaneously with the morphologically very similar *S. areira*. Since then, both taxa have been treated as separate species, as two varieties of a single species, or as the same species, generating conflicts regarding their correct taxonomic identity (Zapater et al. 2018). In this research, *Schinus molle* is used because it is the accepted (POWO 2025, TROPICOS 2025) and most widely used name in the literature referring to the pepper tree of our region. However, the precise designation or differentiation of this species is left to future research.

The pepper tree is an evergreen species widely distributed in arid areas of South America, including Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela (TSO 2025). It has been introduced to several other countries, including Mexico, the United States, Spain, South Africa, and Australia, among others (Blood 2001, Iponga et al. 2008). It tolerates a wide range of adverse conditions, including heat, moderate cold, drought, poor soil, air pollution, and wind, among others (Baldwin 2025, Iponga et al. 2008, UFEI 2025).

Pests and Diseases Affecting Pepper Trees

Pests and diseases have not affected the pepper tree much although pests such as psyllids, aphids, thrips, and mealybugs have been documented, as well as fungal diseases such as *Armillaria*, *Phytophtora*, root rot (UFEI 2025), *Phomopsis schini* (=*Myxosporella schini*) (Carranza 1950, Sutton 1968) and *Botryosphaeria* sp. (Hodel et al. 2024b). The most damaging pest is the pepper tree psyllid (*Calophya schini*), which causes extensive damage, including malformation of new sprouts and, especially deep pitting and galls on leaves (Boa 2008, Downer et al. 1988). It

is nearly always present on leaves, tender new growth, and young flowers (Pinzón and Gonzales 2001). This psyllid has also been reported with a high incidence in Lima, Peru, where the presence of the giant whitefly *Aleurodicus juleikae* has also been reported (Móstiga and Lozada 2019).

Also reported as harmful species are the homopteran *Aethalion reticulatum*, which does not cause significant damage (Schulte et al. 1992) and the lepidopteran *Tolype guentheri*, whose larvae are typically present in great quantities, causing severe defoliation (Boa 2008, Pinzón and Gonzales 2001, Schulte et al. 1992).

In Mexico, beetles of the genus *Macropactylus* and caterpillars of *Lophocampa* sp. and *Rothschildia oribaza* defoliate *Schinus molle*. Sap-sucking homopteran insects, such as *Stenomacra marginela, Clastoptera* sp., *Ceroplastes cirripediformis*, and *Pulvinaria* sp., have also been reported (Cibrián Tovar et al. 1995).

A very common parasitic plant species in Bolivia and Argentina is *Ligaria cuneifolia*, which affects the canopy of pepper trees (Boa 2008, Rivero and Román 2024).

Acosta (2018) refers to two pathogenic fungi that affect the leaves of *Schinus molle*: *Phomopsis schini* (=*Myxosporella schini*) and *Cylindrocladium scoparium*. They cause amphigenous leaf spots measuring one to three mm diameter. They also cause dark spots on the main veins and petioles and elongated, depressed roots that develop into small cankers.

Downer (2020) mentions that Armillaria root rot is a disease that affects trees and woody plants. This pathogen has a broad host spectrum, causing bud rot and acting as a saprophyte; *Schinus molle* is highly susceptible to this pathogen.

More recently, Hodel et al. (2024a, b) reported a new malady in southern California, U. S. A., which they called canopy thinning. This malady is possibly attributed to the combined action of an insect identified as *Empoasca sativae*; a microscopic mite, *Brachytydeus formosus*; and a typically pathogenic fungus, *Botryospharia* sp.

Botryosphaeriaceae pathogens can infect through wounds and natural openings, such as lenticels and stomata, and produce enzymes or toxins that damage and destroy cells and tissues (Flor et al. 2019, Garcia et al. 2021). These fungi cause diseases in a wide range of woody and ornamental plants. Symptoms include wilting, foliage discoloration, dieback, and cankers (Hodel 2009; Hodel et al. 2009, Mayorquín et al. 2012).

Methodology

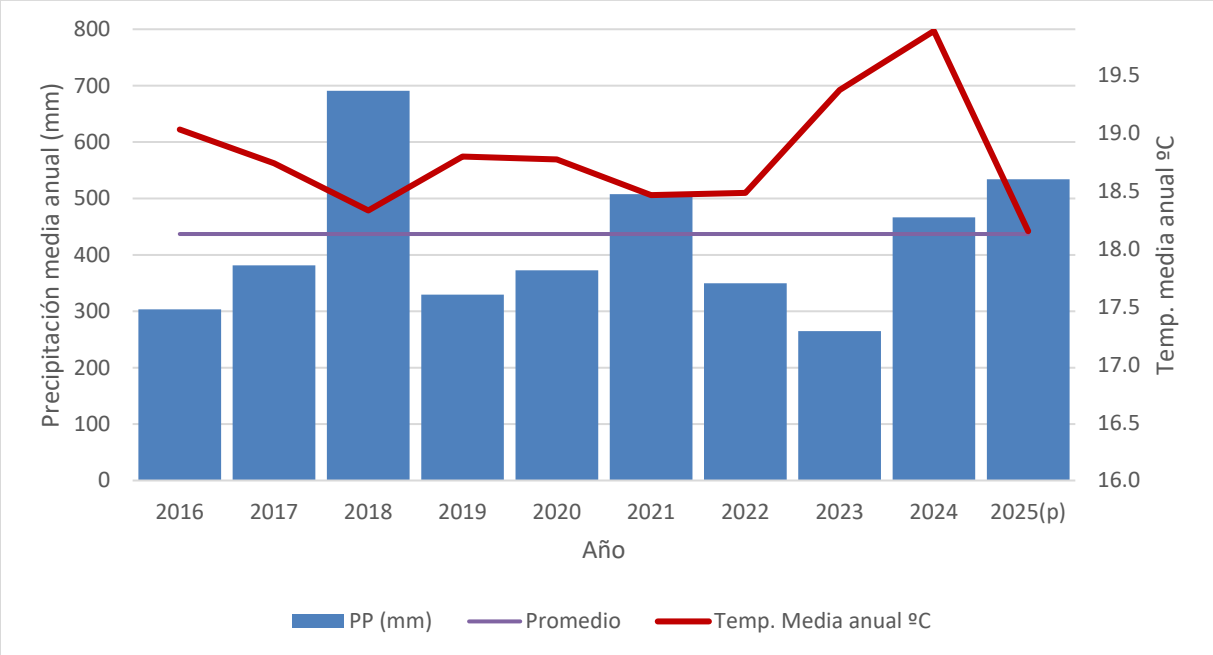
Study Area

This study was conducted in the urban metropolitan area of Cochabamba in the department of the same name and part of the inter-Andean dry valleys of the central and southern Eastern Cordillera of Bolivia (Navarro et al. 2015). Physiographically, it is located within the mesothermal valley zone, with is approximately 2,500 m above sea level (Renner and Velasco 2000).

Climate of the Study Area

The climate is warm temperate with an average annual temperature of 18.1ºC (INE 2025). Rainfall is convective and limited to the rainy season from December to March, and varies between 400 and 500 mm annually (Renner and Velasco 2000, Navarro et al. 2015), with an annual average of 437 mm over the last 35 years (INE 2025) (**Fig. 3**).

The Cochabamba Valley soil has a semi-arid ombrotype, typical for the inter-Andean valley because rainfall is intercepted by the mountain ranges surrounding the valley and little precipitation reaches the interior. Generally, the valley soil, along with the lower slopes of the surrounding mountain ranges, has a xeric bioclimate characterized by eight to nine months of drought (Navarro et al. 2015).



3. Average annual temperature and precipitation, 2016–2025, Cochabamba, Bolivia. (p): Through June 2025, only. *Promedio* = mean. Prepared by the author based on INE data (2025).

4. View of canopy of an affected pepper tree showing an abundance of dead leaves and small, deformed young sprouts.

According to SENAMHI (2025), Cochabamba received a record high rainfall of 278 mm in January of 2025, the highest since 1949. This excessive precipitation might be a determining factor in the emergence of root and foliar pathogenic fungi (Hodel et al. 2024b).

Data Collection and Research Design

Direct observation and sampling were randomly carried out on 71 specimens of pepper trees, 40 of them located in the Cochabamba Botanical Garden and the remaining 31 specimens distributed throughout different areas of the municipalities of Cercado and Sacaba in the department of Cochabamba, Bolivia.

Data was collected from pepper trees in flowerbeds, parks, and plazas in urban public areas between the municipalities of Cochabamba and Sacaba, at elevations between 2,500 and 2,800 meters above sea level. Specimens were selected based on ease of access for the work team. Investigators also made observations of potential pests of the 71 pepper trees in the study.

5. Affected pepper trees show malformed sprouts and dieback.

6. Pinnae damage on pepper trees includes necrotic spots, galls, and oozing.

7. Affected pepper tree leaves show necrotic spots on leaflets, rachis, and young, tender twigs.

Potential pests were observed and identified. Disease symptoms were recorded for pepper tree specimens with a minimum height of four meters. Infections were not quantified for each specimen; this study was limited to identifying the various symptoms and signs of the pathogens that could be causing canopy decline and thinning. Future research should determine the impact that each of the described pathogens has on the pepper tree specimens.

Results

Pest and Disease Symptoms Observed on Pepper Trees

1. Trees show a general decline in vigor and loss of foliage (**Fig. 4**).
2. Leaves and shoots show deformities and necrosis causing dieback (**Fig. 5**).
3. Leaflets show necrotic spots, galls, and generalized damage (**Figs. 6–7**).
4. Resin exudation has been observed on some specimens of young, tender shoots (**Fig. 8**).
5. Some necrotic spots consistent with sucking insects are observed along young, tender branches (**Fig. 9**).
6. Necrosis is also observed on the main vein of leaflets (**Fig. 10**).

Botryosphaeria sp. pathogen

According to Hodel (2024b), Botryosphaeria is a genus comprising up to ten species of mostly harmful fungi in the Botryosphaeriaceae family. These fungi are morphologically diverse, endophytic and/or saprophytic ascomycetes. They are found primarily on woody plants and have a worldwide distribution, except in polar regions. They are frequently associated with destructive vascular diseases of woody plants.

The study by Hodel et al. (2024b) showed that symptomatic tissue of *Schinus molle* in which *Botryosphaeria* was detected, was found in the young, new, current year's growth. Symptoms include dark brown to black sclerified laminar lesions, dark, sometimes “platy” necrotic spots, and lesions on leaves, twigs, and shoots; blackening and dieback of shoot tips, white oozing typically in leaf and twig axils (**Figs. 11–12**); and perhaps a few other symptoms, including general yellowing of the distal pinnae accompanied by necrosis and leaf drop, denuded rachises, dieback, and canopy thinning.

8. Clear-colored resin exudes from affected pepper tree shoots and leaves.

9. Some necrotic spots consistent with sucking insects are observed along young, tender pepper tree branches.

10. Necrosis was also observed on the main vein of pepper tree leaflets.

11. An initial fungal infection of a young pepper tree twig occurred at a twig junction. The white material could be wound exudate.

12. An advanced fungal infection of a pepper tree twig shows darkened, “platy” tissue.

13. The mistletoe *jamillo* has red flowers and green immature fruits on this pepper tree.

14. This pepper tree is heavily infested with the mistletoe *jamillo*. Note the reddish color from the *jamillo* flowers.

Observed, Non-Pathogenic Harmful Agents

Mistletoe: *Jamillo* (*Ligaria cuneifolia*)

Jamillo, belonging to the Loranthaceae family, is a hemiparasitic (GIZ – UCB 2020) or stem-parasitic (Rustán et al. 2003). It is an herbaceous plant native to the inter-Andean forests of Bolivia. It grows primarily on pepper trees (**Figs. 13–14)**.

Jamillo infestation in peppers trees in the Cochabamba Valley is considerable, ranging from 23% to 87%, with an average of 61% of the individuals studied. This infestation weakens the host tree and can even kill it (Rivero and Román 2024).

Pepper tree psyllids (*Calophya schini*)

The pepper tree psyllid belongs to the order Hemiptera, suborder Sternorrhyncha, family Calophyidae. Nymph damage includes formation of the typical galls and perforations on the leaves, petioles, twigs, and shoots of their host (**Figs. 15–16)**. These galls are formed because of the insect's sap suction. When severe, this infestation can cause defoliation and deformation of

15. Adult pepper tree psyllid (*Calophya schini*). From Rorabaugh (2017).

16. The pepper tree psyllid causes galls on leaves and pinnae of the pepper tree.

leaves and young shoots, but generally does not result in the death of the tree (Díaz 2017, Burckhardt and Basset 2000).

When the infestation is severe, tree deterioration is evident (Burckhardt and Basset 2000). Pinzón and Gonzales (2001) reported that damage caused by the psyllid was observed on vegetative and reproductive organs, and on young, tender stems and leaves, especially on new leaves and flower buds. Despite being a sap-sucking insect, the most significant damage is related to tissue malformation as a result of its developmental habits. When the infestation level is high, the density of lesions per leaflet is also high, and it can cause significant tissue deformation and, occasionally, premature defoliation of the tree and drying and death of branches.

Leafhopper (*Aethalion reticulatum*)

A member of the order Hemiptera, suborder Auchenorrhyncha, family Aetolionidae, this pest is found abundantly on different tree species, particularly jacaranda (*Jacaranda mimosifolia*) and golden rain (*Tecoma stans*). The pest, found mainly on branches and young, tender shoots (**Fig. 17**), is a sap sucker and weakens the tree, allowing viruses, bacteria, and fungi to enter through its feeding wounds.

17. The leafhopper *Aethalion reticulatum*, from eggs to adults are on twigs of a pepper tree.

Thorn bug (*Enchenopa* sp.)

A member of the order Hemiptera, suborder Auchenorrhyncha, family Membracidae, the thorn bug has been observed on young pepper tree specimens (**Fig. 18**) and is often associated with ants. A sucking insect that perforates leaves and tender shoots, it causes defoliation, deformed shoots, and necrosis in twigs and young tissue.

18. Adult thorn buds, which exhibit protective behavior toward nymphs and eggs, are perched on this leaf rachis of a pepper tree.

Green leafhopper (*Empoasca* cf. s*ativae*)

A member of the order Hemiptera, suborder Auchenorrhyncha, family Cicadellidae, the green leafhopper (**Fig. 19**) is also mentioned as a potential pest and responsible for canopy thinning of *Schinus molle* in California (Hodel et al. 2024a). This sucking insect perforates leaf tissue, petioles, and tender shoots, possibly causing defoliation, deformed shoots, and necrosis in twigs and young tissue.

19. This green leafhopper *Empoasca* cf. *sativae* is on a young pepper tree twig.

Analysis and Discussion

The defoliation, decline, and canopy thinning processes in the peppertree cannot be attributed to a single pest or pathogen. This problem may be due to a specific stress situation in the trees, caused by various abiotic factors exacerbated by climate change, such as temperature changes, drought followed by excessive seasonal rainfall, aridification, etc. Added to this are human factors linked to urban trees, such as inadequate irrigation, soil compaction and degradation, pruning, and other types of wounds and mechanical damage. This scenario leads to the spread and increased severity of symptoms and damage caused by various diseases and opportunistic pests. In some cases, seemingly harmless endophytic fungi can be transformed into harmful ones (Downer et al. 2022, Hodel et al. 2024).

This initial investigation opens the possibility of conducting future studies that could delve deeper into these topics, as well as correlate the specific effects of each of the identified harmful agents with the hosts and specific environmental conditions.

In a final observation made in mid-August of 2025, a substantial improvement was noted in many of the pepper trees, which was attributable to the presence of winter. Although not particularly cold in this geographical area, with average temperatures of 14.7 C and average minimum temperatures of 1 C, along with low relative humidity and virtually no precipitation, these conditions are not conducive to pathogenic fungal development and can reduce populations of harmful insects, allowing the pepper trees to recover on their own.

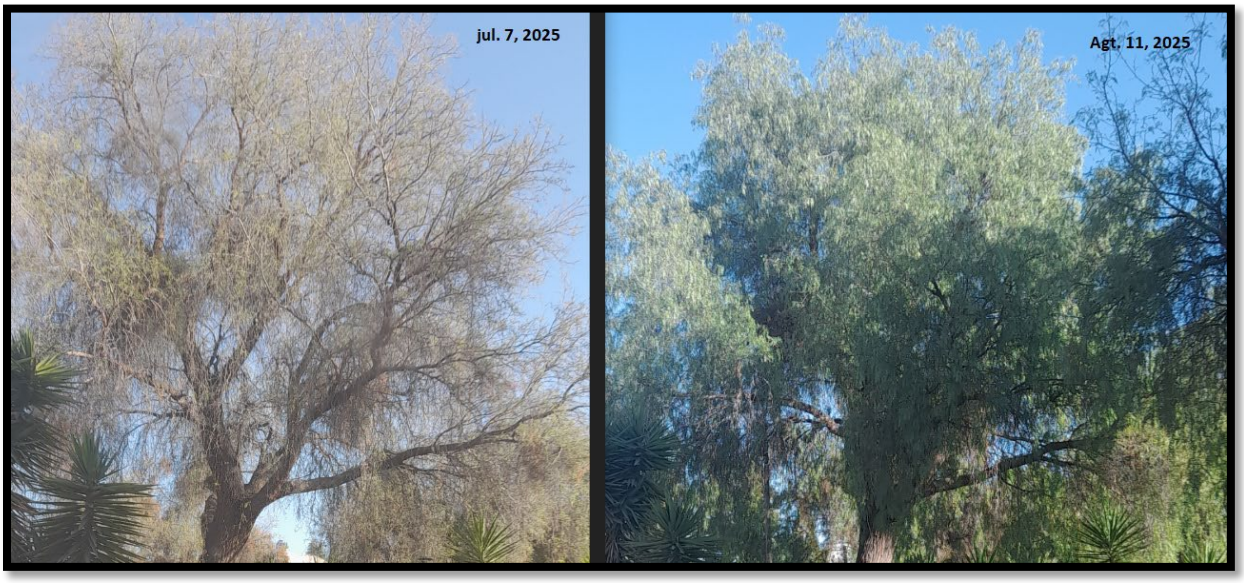


Figure 21. Comparison of the physiological status of pepper tree specimens in July, 2025 (left) and August, 2025 (right).

Conclusions

Observations made in the Cochabamba Valley suggest that pepper trees showed significant decline and loss of foliage during the months of April through July of 2025, coinciding with the end of the rainy season, which was particularly abundant during this period.

Symptoms and signs observed in affected peppertrees correlate with common, harmful parasites and pests identified in the present study and include *jamillo* mistletoe) and harmful insects such as pepper tree psyllids.

Uncommon, harmful insect pests observed on the pepper trees include two leafhoppers and the thorn bug.

However, the most worrisome aspect is the emergence of *Botryosphaeria* fungi, which cause malformation of growth, decline, and dieback of new growth. This pathogen could be aided by the feeding habits of these various insect pests whose piercing mouth parts wound plant tissue, providing entry sites for the pathogen. A particularly intense rainy season, preceded by three hot years with below- or near-average rainfall, might be a determining factor in the appearance of *Botryosphaeria* as well as the proliferation of potential insect pests.

Although canopy decline and thinning have been reversed and the specimens have shown notable improvement since the end of July, *Botryosphaeria* remains dormant in the tree tissues and may reappear beginning in the next rainy season, progressively weakening the pepper trees and affecting their development and normal phenological processes.

Climate change and its associated effects are allowing various harmful agents to become opportunistic and change their habits, affecting other species. Therefore, vigilance and monitoring are essential to prevent the spread of potential pests and vectors that could endanger already stressed and deteriorated urban pepper trees.

Studies are recommended to understand the factors influencing pathogen-host distribution and interaction, in order to assess current and future damage, as well as the biological changes that trees experience due to infection and infestation.

It is also suggested that periodic assessments be conducted on the studied specimens to record any potential increases in infections, infestation percentage, and tree mortality.

Literature Cited

Acosta, N. 2018. Identificación de Enfermedades en las Especies Forestales Producidas en la Unidad de Vivero Forestal. Trabajo final de Carrera. Facultad de Ciencias Agrarias y Forestales. Universidad de La Plata. Argentina.

Baldwin, R. 2025. *Schinus molle*. San Marcos Growers. https://www.smgrowers.com/products/plants/plantdisplay.asp?plant_id=1486 Accessed: 14 August 2025.

Blood, K. 2001. Environmental Weeds: A Field guide for Southeast Australia. C. H. Jerram and Associates, Mount Waverly, Victoria, Australia.

Boa, E. 2008. Guía Ilustrada sobre el Estado de Salud de los Árboles. Reconocimiento e Interpretación de Síntomas y Daños. Organización de la Naciones Unidas para la Agricultura y la Alimentación-FAO.

Burckhardt, D. and Y. Basset. 2000. The jumping plant-lice (Hemiptera, Psylloidea) associated with *Schinus* (Anacardiaceae): systematics, biogeography and host plant relationships. Journal of Natural History 34: 57–155.

Carranza, J. 1950. Antracnosis del aguaribay causada por *Myxosporella schini* sp. nov., en la Argentina. Revista de la Facultad de Agronomía, Universidad Nacional de La Plata 27: 275–81.

Cibrián Tovar, D., T. Tulio Méndez Montiel, R. Campos Bolaños, H. O. Yates, III, and J. E. Flores Lara. 1995. Forest Insects of México. Universidad Autónoma de Chapingo, México.

Díaz, F. 2017. Identificación de Insectos Fitófagos en Especies Leñosas Ornamentales de las Áreas Verdes de la Ciudad de Cajamarca. Tesis de grado. Universidad Nacional de Cajamarca, Perú.

Downer, A. and I. Lacán. 2020. Armillaria Root Rot. UC IPM Pest Notes. University of California, Agriculture and Natural Resources, Publication 74171. Oakland, California.

Downer, A. J., P. Svihra, R. Molinar, J. Fraser, and C. Koehler. 1988. New Psyllid Pest of California pepper tree. California Agriculture 42 (2): 30–31.

Downer, A. J., D. Vega, and T. Michailides. 2022. Botryosphaeria Canker. UC IPM Pest Notes. University of California, Agriculture and Natural Resources, Publication 74177. Oakland, California.

Flor, N., D. Phillips, and P. Harmon. 2019. Botryosphaeria Stem Blight on Southern Highbush Blueberry in Florida. UF/IFAS Extension Plant Pathology Publication PP347.

Garcia, J., D. Lawrence, A. Morales-Cruz, R. Travadon, A. Mineo, AR. Hernandez-Martinez, P. Rolshausen, K. Baumgartner, and D. Cantu. 2021. Phlyogenomics of plant-associated Botryosphaeriaceae species. Frontiers in Microbiology 12: article 652802.

GIZ – UCB. 2020. Guía de Campo Ilustrada de Especies Forrajeras Nativas de los Municipios de Pasorapa, Aiquile y Omereque. Proyecto COTRIFOR. Cochabamba, Bolivia.

Hodel, D. R. 2009. What's killing Whittier's Ficus trees? Preservationist. Fall 2009: 5.

Hodel, D., A. J. Downer, and D. Mathews. 2009. Sooty canker, a devastating disease of Indian laurel-leaf fig trees. Western Arborist 35(4): 28–32.

Hodel, D. R., P. Santos, L. M. Ohara, G. Arakelian, and C. H. Dietrich. 2024a. A preliminary investigation of the new and serious malady of *Schinus molle* canopy thinning. PalmArbor 2024-02: 1–49. *https://ucanr.edu/sites/default/files/2025-03/Schinus%20molle%20Canopy%20Thinning%20394059.pdf*
DOI: *https://doi.org/10.21414/B16P4X*

Hodel, D. R., P. Santos, C. Shogren, B. Fisher, M. F. Rothschild, J. Chinchilla-Vargas, L. M. Ohara, and G. Arakelian. 2024b. A preliminary investigation of the new and serious malady of *Schinus molle* canopy thinning. Part 2. PalmArbor 2024-04: 1–32. *https://ucanr.edu/sites/default/files/2025-03/Schinus%20molle%20canopy%20thinning%20Part%202%20PalmArbor%201%20June%202024.pdf* DOI: *https://doi.org/10.21414/B1G594*

INE. 2025. Medio Ambiente: Clima y Atmósfera. Cuadros Estadísticos Mensuales por Ciudades, Según Año y Mes 1990–2025. Instituto Nacional de Estadística. *https://www.ine.gob.bo/index.php/medio-ambiente/clima-y-atmosfera/* Accessed: 14 August 2025.

Iponga, D., S. Milton, and D. Richardson. 2008. Superiority in competition for light: A crucial attribute defining the impact of the invasive alien tree *Schinus molle* (Anacadiaceae) in South Africa savanna. Journal of Arid Envrironments 72(5) 612–623.

Mayorquin, J. A., J. Downer, D. R. Hodel, A. Liu, and A. Eskalen. 2012. *Ficus* branch canker of Indian laurel-leaf fig. Western Arborist 38(1): 60–61.

Móstiga, M. and P. Lozada. 2019. Insectos y Ácaros Perjudiciales en los Arboricultivos de la Universidad Nacional Agraria La Molina, Perú. IDESIA. Volumen 37(1): 115–124.

Navarro, G., F. Aguirre, and M. Maldonado. (eds.). 2015. Biodiversidad, Ecología y Conservación del Valle Central de Cochabamba. Centro de Biodiversidad y Genética (CBG), Universidad Mayor de San Simón. Cochabamba.

Pinzón, O. and R. Gonzales. 2001. Caracterización biológica, hábitos, enemigos naturales y fluctuación poblacional de *Calophya schini* Tuthill, en la especie forestal ornamental Schinus molle L. en Bogotá. Revista Científica. Año 3, Nº1. ISSN:0124-2253.

POWO. 2025. *Schinus molle*. Plants of the World Online. https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:71044-1 Accessed: 20 September 2025.

Renner, S. and C. Velasco. 2000. Geología e Hidrología del valle central de Cochabamba. Servicio Nacional de Geología y Minería, Nº34. La Paz, Bolivia.

Rivero, J. and C. Román. 2024. Infestación de Jamillo (*Ligaria cuneifolia*) en árboles de Molle (Schinus molle) en el Valle de Cochabamba. Acta Nova 11(4) (noviembre): 344 – 352. ISSN: 1683-0768.

Rivero, J. and M. Meave. 1998. Sistematización de los Estudios y Trabajos de Fenología de Especies Nativas. Programa de Repoblamiento Forestal PROFOR, Prefectura_IC-COSUDE. Cochabamba.

Rorabaugh, J. 2017. Psílido del Pirul *Calophya schini*. https://colombia.inaturalist.org/taxa/387008-Calophya-schini Accessed: 14 August 2025.

Rustán, J., D. Balseiro, F. Degrange, K. Halpen, E. Sferco, M. Luna, and G. Giudice. 2003. *Características* Estructurales de los Haustorios de *Ligaria cuneifolia* (Loranthaceae) de Argentina. XXIX Jornadas Argentinas de Botánica. San Luís, Argentina.

Schulte, A., C. Rojas, and R. Rojas. 1992. Reforestación y Agroforestería en los Andes – Uso Sostenido, Conservación y Restauración de Suelos con Árboles y Arbustos Nativos: 1. Apuntes sobre el Molle (*Schinus molle*). ETSFOR-FUPAGEMA-AGRUCO-ECO.

SENAMHI. 2025. Boletín Informativo de Predicción Climática para el Trimestre Febrero, Marzo y Abril 2025 Departamento de Cochabamba. Ministerio de Medio Ambiente y Agua - Servicio Nacional de Meteorología e Hidrología. BOL-PC-Nº02-2025.

Sutton, B. 1968. *Phomopsis schini* (Carranza) comb. nov. Transactions of the British Mycological Society 51: 616–618.

TROPICOS. 2025. *Schinus molle*. TROPICOS. https://www.tropicos.org/name/1300267 Accessed 20 September 2025.

TSO. 2025. *Schinus molle.* Trees and Shrubs Online. International Dendrology Society. https://www.treesandshrubsonline.org/articles/schinus/schinus-molle/ Accessed: 14 August 2025.

UFEI. 2025. *Schinus molle*. SelectTree. https://selectree.calpoly.edu/tree-detail/1322 Accessed: 14 August 2025. https://selectree.calpoly.edu/tree-detail/1322 Accessed: 14 August 2025.

Zapater, M., V. H. Aquino, C. Flores, and E. Lozano. 2018. Nomenclatura y taxonomía de *Schinus areira* en Argentina. El Boletín de la Sociedad Argentina de Botánica. 53(4): 665–671.

Jaime G. Rivero-Moreno is an independent researcher in plant sciences in Bolivia.
etmcba@gmail.com

Publication Date: 23 September 2025.
PalmArbor: *https://ucanr.edu/site/hodel-palms-and-trees/palmarbor*

ISSN 2690-3245

Editor-In-Chief: Donald R. Hodel
Hodel Palms and Trees: *https://ucanr.edu/site/hodel-palms-and-trees*