Pests and Diseases of *Pterocarpus santalinus*

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Abstract

The host of benefits forests provide are indispensable, and the flora and fauna of the forests are vulnerable to multiple threats. Apart from some abiotic factors such as fire, wind, storms, and climate change, there are many biotic factors like insects and diseases, which can have a devastating impact on the forest landscape. Man-made forests in general and particularly trees are susceptible to pests and diseases. Red sanders, a species with high timber value, is also affected; however the information on disease and pests is scanty. The tree is introduced in many geographical locations, and plantations are successfully maintained in various climatic zones. For sustainable utilization and to meet the global demand, the red sanders cultivation needs to be encouraged. For achieving healthy and resilient plantations, it is imperative to have a pest and disease management in place. In this chapter infections and infestations reported in red sanders are reviewed.

Keywords

Red sanders · Fungal infestation · Nematode infestation · Termite infestation · Heart wood borer

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10.1 Introduction

Pterocarpus santalinus is in high demand in international market and is known for its gorgeous dark scarlet red wood with superlative technical qualities coupled with many medicinal properties. Due to overexploitation red sanders is endangered now, and this endemic tropical tree species from India is in need of restoration (Arunkumar and Joshi 2014). As this precious tree is endemic and threatened, great care should be taken for its survival and restoration. According to Luna (2005), forest fire causes extensive damage to young red sanders seedlings, sometimes wiping them completely. Young plantation of red sanders is also found to be badly affected by climbers and other competitive forest plants. This timber-yielding species has inherent resistance against attack by fungi, insects, and marine borers. Red sanders will not encounter any serious pest problem either in nurseries or in plantation. Due to changes in silvicultural and pre-harvesting practices, this property of high durability due to inherent resistance has become unreliable and reportedly interferes with their durability performance (Sundararaj et al. 2015). The main objective of this chapter is to provide an insight and better understanding of the pests and diseases encountered by *Pterocarpus santalinus.*

10.2 Fungal Infestation

Sankaran et al. (1984) reported leaf blight of *P. santalinus* caused by fungi *Sclerotium rolfsii*. Apart from *Sclerotium rolfsii*, there are many other fungi causing foliage blight in *P. santalinus*. *Colletotrichum gloeosporioides*, *Coniella fragariae*, *Phomopsis* sp., *Phoma glomerata*, and *Phoma eupyrena* are the important fungal pathogens which cause foliage infection in red sanders.

In Kerala during a routine forest survey in 1985, the pink disease caused by fungal pathogen *Corticium salmonicolor* was recorded in *Pterocarpus santalinus*. Rajasekhar et al. (1994) reported leaf spot disease in red sanders, and the causative agent is *Cylindrocladium scoparium*. This organism upon infection causes visible spots on the leaves of *P. santalinus*. During winter a severe leaf spot disease of red sanders was observed in Kadapa, Chittoor, and Nellore districts of Andhra Pradesh. The symptoms of the disease observed under field conditions were obvious pinhead-sized light-brown spots, water-soaked lesions which later turn dark brown, with central near whitish zone especially on the upper surface of the leaf. Premature leaf fall may occur during severe attack. Two or more spots may coalesce to form irregular patches which may involve major damage to leaves. At the center of the old lesions, shot holes may appear. However, infections were not noticed on the other plant parts (Rajasekhar et al. 1994). Reddy and Dayanand (1983) investigated the seed-borne mycoflora of red sanders (*Pterocarpus santalinus* Linn. f.). They reported *Aspergillus niger*, *A. flavus*, *Cladofiriwn cladosporioides*, and *Fusarium* sp. and affirmed seed infections due to these fungi in red sanders.

P. santalinus raised in root trainer nurseries of Kerala were found to be affected with foliage diseases. *P. marsupium* and *P. santalinus* were affected with foliage blight diseases under nursery conditions. In conducive edaphic and environmental

factors, inoculum of most of the nursery pathogens activates in the presence of susceptible host. However, chances of seedling infection will be less even under conducive environmental conditions as inoculum potential of pathogens is considerably negligible in soilless medium employed in root trainer nurseries (Mohanan et al. 2005). Though root trainer nurseries used soilless or soil-free growing media maintained under hygienic conditions, infection by *Sclerotium rolfsii* in both the species is still recorded. Both the *Pterocarpus* species are highly susceptible to fungus, and *Sclerotium rolfsii* is a major cause for the spread of the foliage blight. Most of the soil-inhabiting, disease-causing fungi subsist mainly on the dead organic material in the presence of surplus, readily available nutrients in the organic compost, whereas soilless media are least attractive to the pathogens, and limited nutrients cause competition among them, and hence there should be less infections in soilless media root trainer nurseries. The compost prepared from forest weeds is the major constituent of the growing medium in root trainers, and it is suspected that sclerotium of the pathogen which is very resistant to environmental stress persisted in the compost and contributed to the disease (Mohanan et al. 2005).

10.3 Insect Pests

Fruit, seeds, leaves, and trunk of the fully grown trees in forest ecosystem are known to be attacked by numerous genera of insects. The pest infestation can cause devastating effects on and wipe of certain susceptible species. Though abundant population of *Eotetranychus sexmaculatus* (Riley) of family *Tetranychidae* was reported in Baruipur of West Bengal, there it had no damaging effect on *P. santalinus*. Sporadic infestation of *Planococcus* species of family Pseudococcidae was found in Gosaba of West Bengal. As it was least abundant, no noticeable damage was seen in the plant *P. santalinus* (Jash et al. 2018). It is to be noted that *P. santalinus* does not occur naturally in West Bengal, perhaps authors have the pests on trees of red sanders planted there. Evidently in mature stems and roots of *P. santalinus*, no serious insect pest and disease were observed. However, decrease in seed viability is observed and seeds are prone to seed borer. By proper drying (up to 12% moisture) and using carbon disulfide in storage, these seed borers can be controlled to some extent. Leaf-eating insects and white grub attack early growth stages of *P. santalinus* plants in nursery. These pests were controlled by spraying 0.003% endosulfan at fortnightly intervals and application of phorate 10 G near the root zone. Seed treatment with thiram at 3 g/kg of seed is essential to keep the plants disease-free in nursery and early stages of development in the field (Anonymous 2007). Caterpillars of Pyralidae (Lepidoptera) attack red sanders poles generally at the fork of the tree. Defoliators attack red sanders during summer, but damage is reduced during heavy monsoon. Leaf-eating caterpillars damage *P. santalinus* crop during April-May and can be controlled by spraying 0.2% monocrotophos twice at weekly intervals (National Medicinal Plants Board 2008).

10.4 Nematode Infestation

Nowadays in forests, diseases caused by nematodes are recognized as a significant problem, and it is a density-dependent one and becomes visible when nematode population exceeds critical threshold of economic damage. Limited information is available on diseases and nematode population dynamics in forests of Tamil Nadu where red sanders are naturally distributed. Study conducted for a period of 1 year at Sennamalaikaradu, Mettupalayam, and Coimbatore revealed the presence of soil and root population of parasitic nematodes, viz., *Helicotylenchus dihystera*, *Hoplolaimus seinhorsti*, *Meloidogyne incognita*, and *Tylenchorhynchus mashhoodi*, in red sanders plantations (Sivaprakash et al. 2009a, b). In this area heavy rainfall of 45.0–233.3 mm is observed during October followed by June and August which influences the soil population of *H. dihystera* and *H. seinhorsti*. These species were found to be maximum in number during these months, i.e., 35.2 and 14.6 per 200 g soil. During the month of October, the population of *H. dihyslera* and *H. seinhorsti* was found to be 8.79 per 5 g root and 7.3 per 5 g of root, respectively (Sivaprakash et al. 2009b).

Pathogenicity of the *Hoplolaimus seinhorsti* on red sanders was assessed by conducting an experiment in a glass house in 25 × 15 cm bags filled with steam-sterilized fine sand mixed with red earth in the ratio of 3:1. Eight days of pre-sowing treatment was done for the freshly collected seeds by presoaking continuously in normal water by changing water daily. After 15 days of germination, the plants were infested with adults and juveniles of *Hoplolaimus seinhorsti* at the rate of 0, 100, 200, 400, and 600 larvae per pot around the root zone. With the increasing level of initial inoculum, significant progressive reduction in length and weight of shoot and root was observed. The multiplication rate of *H. seinhorsti* was found to be 9.3–100 larvae per kg soil. When soil is infested with 100 larvae/kg, there is no reduction in chlorophyll content, whereas 600 larvae/kg soil significantly reduced the chlorophyll content in red sanders.

When the nematode population level exceeded 200/kg soil stomatal conductance, transpiration rate and net photosynthetic rate of *P. santalinus* (Sivaprakash et al. 2009b) are affected significantly. Sivaprakash et al. (2009a) studied stained sections of *P. santalinus* root revealed that *H. seinhorsti* acted not only as ectoparasite but also as semi-endoparasite and endoparasite. Most often it is observed that nematodes feed semi-endoparasitically causing cell collapse and deformation in the cortex forming cavities. Plant-parasitic nematodes like *Aphelenchoides*, *Helicotylenchus*, *Hemicriconemoides*, *Hoplolaimus*, *Longidorus*, *Paralongidorus*, *Pratylenchus*, *Xiphinema*, *Rotylenchulus*, *Rotylenchus*, *Siddiqia*, *Psilenchus*, *Trichodorus*, and *Tylenchorhynchus* have been reported to infect and cause disease in *Pterocarpus santalinus* (Kavitha et al. 2017)

10.5 Pest and Termite Infestation of Timber

The infestation of timber of *Pterocarpus santalinus* by heartwood borer was pragmatic in timber depots of Tirupati, Rajampet, Adurupalli, and Kadapa forest in Andhra Pradesh. Powder-post beetles are classified under the subfamily Lyctinae comprising a group of 70 species of wood-boring beetles. These make up the super family Bostrichoidea along with common furniture beetles, skin beetles, deathwatch beetles, spider beetles, and others. These powdered dust beetles are considered pests, and they infest deciduous trees, over time reducing the wood to powdery dust. In Andhra Pradesh from Nellore forest division, Adurupalli forest red sanders depot and Venkatagiri forest red sanders depot, powder-post beetles' infestation was detected. During growth cycle these powder-post beetles spend months or years inside the wood, feeding mainly on the starch content. The presence of these pests become apparent only when they emerge as an adult as they leave behind pinhole-sized openings which are often called "shot holes." They may also leave piles of powdery frass below. Depending on the species of the beetles, shot holes normally range in diameter from 0.79 to 3.2 mm. Cycle of generation continues if wood conditions are right as female beetles may lay their eggs and re-infest the wood. Infestation of termites, a group of eusocial insects of epifamily Termitoidae and order Blattodea, was observed in red sanders wood at Adurupalli and Venkatagiri depots, Nellore forest division, Andhra Pradesh (Soundararajan and Joshi 2012).

Postharvested red sanders wood is attacked by powder-post borers, sapwood borers, and termites when stored for a long time. To avoid this they should be checked immediately to evade total destruction of wood. By spraying and dipping with an appropriate solvent-based insecticide like 0.1–0.25 monocrotophos or 0.2% of paradichlorobenzene in kerosene oil, boron, or lindane formulation or by syringe injections into the flight holes, insect attack may be circumvented. By flooding the wood galleries with light organic solvent-based wood preservative formulations, having broad-spectrum of fungicides as well as insecticides, termites can be destroyed. By fumigating with methyl bromide or trimethyl borate or with ammonia, we can control termites though we cannot control re-infestation. We can also control the postharvest pest infestation of red sanders by drying the wood to 12% moisture content and by maintaining proper ventilation in the depot by air circulation. Contact insecticides should be sprayed frequently, and continuous monitoring of timber should be a top priority, and removal of completely infested piece/log regularly is a necessity (Soundararajan and Joshi 2012).

10.6 Fungal Infestation of Timbers

At Adurupalli and Venkatagiri depots of Nellore forest division, Andhra Pradesh, the wood decay fungus infestation was noticed in red sanders. The four fundamental requirements of the wood decay fungus are oxygen, favorable temperature, water, and nutrients. When the moisture content of the wood exceeds 20–30%, with optimal temperature of (32–90 °F), an adequate supply of oxygen, and nutrient

source, wood-decaying fungal growth will be maximum. Variety of wood-decaying fungus digests the moist wood causing it to rot. Some wood-decaying fungus can also infest dead wood to cause brown rot. The fungi which not only grow on wood but also decay it are called lignicolous fungi. Lignicolous fungi consume wood either by digesting carbohydrate or by decaying lignin (Soundararajan and Joshi 2012). As water is the enemy of wood, moisture control must be an integral part of prevention of wood decay fungi. Borate can prove as an effective agent in killing the wood-decaying fungi (Soundararajan and Joshi 2012).

There are very limited number of studies regarding pathology of red sanders which leaves lot of scope for future research.

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