Disease problems in root trainer forest nurseries in Kerala State and their management

C. Mohanan, N. Ratheesh, Laya P. Nair and K.C. Rajesh Kumar

Division of Forest Pathology, Kerala Forest Research Institute, Peechi 680 653 Kerala
E-mail: mohanan@kfri.org

Disease survey was carried out in forest nurseries in the Kerala State, India during 2000–2002. Disease incidence, severity and spread were recorded and causal agents were isolated and identified. A total of 27 forestry species raised in root trainer nurseries including *Acacia mangium, A. auriculiformis, Cassia fistula, C. siamea, Dalbergia latifolia, Eucalyptus spp., Gmelina arborea, Pterocarpus marsupium, P. santalinus, Santalum album, Tectona grandis,* etc. were found affected with foliage diseases. Since, soil-less or soil-free growing media were used in root trainers and general hygienic conditions were maintained in the nurseries, soil-borne diseases seldom occurred. However, *Pseudomonas tectonae* causing seedling wilt was recorded in teak and *Sclerotium rolfsii* causing foliage blight in *Pterocarpus* spp. The common nursery pathogens like *Rhizoctonia solani, Cylindrocladium* spp*., Pythium* spp., *Fusarium* spp., were rarely encountered. Often seedling congestion in root trainers led to foliage infection by pathogens like *Colletotrichum gloeosporioides, Coniella* spp*., Pestalotiopsis* spp*., Alternaria alternata, Phomopsis* sp*., Guignardia* sp. and *Curvularia* sp. In general, severity and spread of foliage infection caused by most pathogens was low in all the nurseries, except leaf blight caused by *Phoma glomerata*. *T. grandis* and *C. fistula* seedlings were highly susceptible to *P. glomerata.* Carbendazim (0.05% a.i.), carboxin (0.01% a.i.) and mancozeb (0.1% a.i.) were found very effective in controlling the foliage infections in nurseries. Bactericide (Streptomycin sulphate 90%w/w + Tetracycline hydrochloride 10%w/w) was found effective in managing the bacterial infections.

Introduction

During the past few years, forest nursery practices in the Kerala State have undergone a tremendous modifications. Introduction of root trainers in forestry sector and thereby the technological changes in seedling production brought out a major impact on nursery management. Seedling health has been given more importance which further widened the scope of phyto-sanitary measures. Growing media suitable to the plant species have been developed and seedling production technology has been standardized. Maintaining the seedling crops under tropical climate is one of the major problems confronting the nursery managers. During this period, disease problems may occur in succession and if timely intervention is not performed the entire seedling crop may be devastated by one or other diseases. In root trainers, the seedlings require a maximum period of 90 days of growth and hence a rigorous management is possible.

Earlier, as disease hazards in forest nurseries have became very common which often upset the entire planting programme, systematic studies and management of economically important diseases were taken up during 1980s and 1990s and nursery management practices for prime forestry species, have been standardized (Sharma et al. 1985; Sharma and Mohanan 1992, Mohanan, 2001). The present study was undertaken to assess the disease situation in nurseries employing root trainer technology for raising seedlings and also to manage the disease(s), if any, occur.

Materials and methods

Disease survey was carried out in Central nurseries located at Kulathupuzha ($8^0$54'N, $77^0$44'E), Chettikulam ($11^0$50'N, $75^0$41'E), Valluvassery ($11^0$18'N, $76^0$16'E), and Cheruvanchery ($11^0$50'N, $75^0$41'E). Besides, root trainer nurseries raised at Kerala Forest Research Institute Campus, Peechi and Forest Field Station at Palappilly, and KFRI Sub-Centre, Nilambur were also surveyed during 2000–2002. Disease incidence, severity and spread were recorded using a Disease scoring scale (Table 1) and disease specimens were collected and brought to the laboratory for isolation and identification of causal organisms.

Table 1. Disease scoring scale.

Disease severity	Disease severity code	Disease severity scale, percentage seedlings affected
Nil	0	0
Low	L	1–25
Medium	M	26–50
Severe	S	51–75 or > 25% seedlings dead

Potato Dextrose Agar (PDA) medium was used for isolating and sub-culturing fungal organisms, while Nutrient Agar (NA) medium was used for isolating and maintaining bacterial pathogens. Isolation and purification of causal organisms were carried out employing standard procedures and identification up to species level was made. As far as possible, confirmation of pathogenicity of most causal agents was made through inoculation experiments employing root trainer seedlings.

Fungicides and bactericide were screened against important fungal and bacterial pathogens using standard techniques and most effective fungicides/bactericides at appropriate dosage were recommended and applied in the nurseries for controlling the respective disease(s). Observations on the effect of chemical treatments against diseases were recorded from the nurseries. General nursery management practices followed in each nursery were recorded and data on growing media used, their composition and pH were also collected.

Results and discussion

Disease survey conducted in nurseries located at different parts of the State revealed that root trainer seedlings are almost free from soil-borne fungal diseases like damping-off, collar rot and wilt irrespective of the conducive climatic conditions prevailed in the nurseries. However, most of the species raised in root trainers suffered from one or the other foliage diseases, mostly incited by air-borne inocula of pathogens, the severity of which varied from nursery to nursery depending on the nursery management practices and prevailing environmental conditions. The common nursery pathogens like *Rhizoctonia solani* Kühn, *Cylindrocladium* spp., *Fusarium* spp. and *Pythium* spp. which cause various diseases at different growth phases of seedlings were seldom recorded in root trainer nurseries. *R. solani*, the most potential pathogen in forest nurseries which exists in different Anastomosis groups (Mohanan 2001) and having a wide host range was not encountered in the root trainer nurseries during 2000 and 2002. The details on the diseases affecting the seedlings *Acacia auriculiformis* A. Cunn., *A. mangium* Willd., *Aegle marmelos* (L.) Corr, *Albizia lebbeck* (L.) Willd., *Artocarpus heterophyllus* Lam., *Azadirachta indica* A Juss., *Cassia fistula* L., *C. siamea* Lam., *Casuarina equisetifolia* Forst, *Cinnamomum zeylanicum* Garc. Ex Bl., *Dalbergia latifolia* Roxb, *Delonix regia* (Boj.) Rafin, *Dysoxylum malabaricum* Bedd. ex. Hiern, *Eucalyptus citriodora* Hook, *E. grandis* Hills ex Maiden, *E. tereticornis* Sm, *Garcinia gummigutta* (L.) Robs., *Gluta travancoricus* Bedd, *Gmelina arborea* Roxb, *Grewia tillifolia* Vahl., *Lagerstroemia microcarpa* Wt., *Pterocarpus marsupium* Roxb., *P. santalinus* L., *Santalum album* L., *Tectona grandis* L., *Terminalia bellirica* (Gaertn.) Roxb. *T. crenulata* Roth and their causal agents are given in Table 2.

Seedling congestion in root trainers was found to be the major factor for the incidence and spread of foliage diseases. Pathogens like *Colletotrichum gloeosporioides* (Penz.) Sacc., *Pestalotiopsis* spp., *Alternaria alternata* (Fr.) Kiessler, *Phoma glomerata* (Corda.) Wollenw. & Hochapf, *P. eupyrena* Sacc, *Phomopsis variosporum* Sharma & Mohanan were found associated with the foliage diseases of seedlings. In general, severity and spread of foliage diseases caused by most pathogens was low in all the nurseries, except the foliage blight caused by *P. glomerata*. The pathogen was found widespread in nurseries and caused severe foliage infection in teak. In teak seedlings, *P. glomerata* along with *P. eupyrena* caused severe damage to the seedlings. In teak, the pathogens cause dark greyish brown necrotic lesions on foliage, usually at the margin and tip of the leaves or at the base of the petiole which coalesce and spread to the entire leaf lamina. The infected leaves show an upward curling and become brittle and withered. The disease also affects the leaf petiole and seedling stem. Severe infection leads to seedling blight. In *Cassia fistula*, the pathogen caused severe leaf blotch which led to defoliation and seedling mortality. Eucalypts seedlings raised in all nurseries were found almost free from any major diseases, except foliage blight caused by *Coniella* spp., *Cylindrocladium* spp. and *Kirramyces eucalypti* (Cook & Massee) J.Walker, the major pathogens in eucalypt seedbed nurseries were rarely encountered.

As soil-less or soil-free growing media were used in root trainers and general hygienic conditions were maintained in nurseries, most of the soil-borne diseases were excluded from the nurseries (Mohanan 2000a,b). However, foliage blight caused by *Sclerotium rolfsii* was recorded in both *P. marsupium* and *P. santalinus*. Both the host species are very susceptible to the Sclerotium blight in seedbed nurseries (Sankaran et al. 1986). Inoculum of most of the nursery pathogens activates in presence of a susceptible host under conducive edaphic and environmental factors. However, in root trainers with soil-less growing medium, the inoculum potential of pathogen is considerably negligible and thus chances of seedling infection will be less even under conducive environmental conditions. Most of the soil-inhabiting, disease causing fungi subsist mainly on

Table 2. Diseases recorded in root trainer nurseries. Nursery, host plant, disease severity and pathogen(s) associated.

Nursery[1)]	Host plant	Disease	Disease severity[2)]	Pathogen(s) associated
C, CK,V, K, P	*Acacia auriculiformis*	Leaf blotch	Low	*Alternaria alternata, Curvularia* sp.
V,K,P	*Acacia mangium*	Leaf spot	Low	*Glomerella cingulata, Pestalotiopsis uvicola, Guignardia* sp.
P	*Aegle marmelos*	Leaf blotch	Low	*Phomopsis* sp., *Phoma* sp.
K,CK	*Albizia lebbeck*	Leaf spot	Low	*Colletotrichum capsici*
N,K	*Artocarpus heterophyllus*	Leaf blotch	Low	*G. cingulata*
C,P,K	*Azadirachta indica*	Leaf & twig blight	Medium	*G. cingulata, Fusarium* sp., *Phomopsis* sp.
V,P	*Cassia fistula*	Leaf blotch	Medium	*G. cingulata, Phomopsis* sp., *Curvularia pallescens, Phoma glomerata*
V	*Cassia siamea*	Leaf spot	Low	*Pestalotiopsis tecomicola*
V	*Casuarina equisetifolia*	Leaf tip blight	Low	*G. cingulata, Phomopsis* sp.
P	*Cinnamomum zeylanicum*	Leaf blotch	Low	*G. cingulata, Sclerotium rolfsii*
V	*Dalbergia latifolia*	Leaf spot	Low	*Colletotrichum gloeosporioides, Phomopsis* sp.
P,CK	*Delonix regia*	Leaf spot	Low	*Guignardia* sp., *Phomopsis* sp.
P,PP	*Dysoxylum malabaricum*	Leaf spot	Medium	*C. gloeosporioides, Phomopsis* sp.
K	*Eucalyptus citriodora*	Leaf spot	Low	*Coniella minima, Phomopsis* sp., *Marsonina* sp.
K,V,CH	*Eucalyptus grandis*	Leaf spot	Low	*Coniella fragariae, Cylindrocladium quinqueseptatum*
CH,CK,V, K,P,N	*Eucalyptus tereticornis*	Leaf spot	Low	*C.fragariae, C. quinqueseptatum, C. gloeosporioides, Phomopsis* sp., *Kirramyces eucalypti*
P,CH,N	*Garcinia gummigutta*	Leaf blotch	Medium	*C. minima, G. cingulata*
P	*Gluta travancoricus*	Leaf blotch	Medium	*Pestalotiopsis* sp.
CH	*Gmelina arborea*	Leaf blotch	Low	*Pseudocercospora ranjita*
K,P	*Grewia tillifolia*	Leaf blotch	Low	*Phomopsis* sp., *Guignardia* sp.
V	*Lagerstroemia microcarpa*	Leaf spot	Low	*C. gloeosporioides*
V,CK	*Pterocarpus marsupium*	Leaf blight	Medium	*Sclerotium rolfsii*
V	*Pterocarpus santalinus*	Leaf blight	Medium	*S. rolfsii*
			Low	*Phomopsis* sp.
CK	*Santalum album*	Leaf spot	Low	*G. cingulata, Guignardia* sp.
CK,V,K,P	*Tectona grandis*	Collar rot	Low	*Pseudomonas tectonae*
		Wilt	Severe	*P. tectonae*
		Leaf blight	Medium	*Phoma glomerata, P. eupyrena, C. gloeosporioides, Phomopsis variosporum*
P	*Terminalia bellirica*	Leaf spot	Low	*Phomopsis sp., Guignardia* sp.
P	*Terminalia crenulata*	Leaf blotch	Low	*Pestalotiopsis maculans*

[1)] C = Central nursery Cheruvanchery; CK = Chettikulam; V = Valluvassery; K = Kulathupuzha; P = nursery at Peechi; N = Nilambur; PP = Palappilly.

[2)] Percentage of seedlings affected. Low = 1–25%; Medium = 26–50%; Severe = 51–75% or 25% seedlings dead.

dead organic materials and the presence of surplus, readily available nutrients in organic compost in root trainer cells makes less competition among the pathogens for the nutrients and thus least attractive for infection of seedlings. The compost prepared from forest weeds is the major constituent of the growing medium in root trainers and it is suspected that the sclerotium of the pathogen which is very resistant to environmental stress persisted in the compost and contributed to the development of disease. Susceptibility of the host (*Pterocarpus* spp.) is also a major factor for the development and spread of the disease.

Bacterial seedling diseases caused by *Pseudomonas tectonae* were also recorded in teak seedlings. The bacteria cause cotyledon rot, collar rot, seedling wilt, and foliage infection. The disease appears as water-soaked lesions on cotyledons and foliage and become dark greyish brown. The lesions spread and cause rotting of the affected tissues in cotyledon, seedling stem and foliage. The bacteria also cause seedling wilt in teak; the infection is systemic and produced symptoms characteristics of vascular wilt drooping of leaves, epinasty and wilting. As in conventional nursery beds, spread of disease through root contact is not occurring in root trainers, however, physical contacts of infected foliage to healthy seedlings in the root trainer blocks spread the disease. Moderate to severe disease incidence and seedling mortality in teak seedlings were recorded at Central Nursery, Kulathupuzha in 2000 and 2001. The source of inoculum may be either the potting medium or water. In the case of bacterial infection, all the affected seedlings are not killed outright. Often many seedlings may become carrier of bacterial pathogens, without showing any visible symptoms of disease. Hence, there is possibility of transferring the disease from nursery to the field through mildly infected planting stock. In seedbed nurseries, bacterial collar rot and wilt cause severe damage to the nursery stock. The seedbed nurseries raised in high rainfall areas were reported to be affected severely by the bacterial pathogen (Sharma et al. 1985, Mohanan et al. 1997).

In nurseries, application of fungicides, Carbendazim (0.05% a.i.), Dithane M45 (0.1% a.i.) against foliage diseases gave good results. For controlling seedling blight and foliage diseases caused by *Phoma glomerata* and *P. eupyrena*, application of Dithane M45 was found very effective. Application of a bactericide, Streptomycin (Streptomycin sulphate 90% w/w + Tetracycline hydrochloride 10% w/w) at the rate of 6 g per 8 l of water by drenching the seedlings gave good control of seedling infection caused by *P. tectonae.*

Conclusions

In root trainer nurseries, soil-borne fungal diseases seldom occur mainly due to the use of soil-less or soil-free growing media and maintaining the nursery in hygienic conditions. Foliage infections caused by air-borne fungal pathogens affect the seedling crops and seedling congestion may be the primary influencing factor for the incidence and spread of the disease. Among the fungal pathogens causing foliage infection, *Colletotrichum gloeosporioides, Coniella fragariae, Phomopsis* sp., *Phoma glomerata* and *P. eupyrena* are the important ones. Though, the new technology offers production of high quality healthy planting stock, application of proper fungicide(s) at proper time is required to control the foliage diseases. Otherwise, mild foliage infection may flare up and cause severe damage to the seedling crops.

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