

Survey of *Eucalyptus* Nursery Diseases in Central and South West Ethiopia

Kumela Regasa Tiki

Central Ethiopia Environment and Forest Research Center, Addis Ababa, Ethiopia

Email address:

kumelaregasa71@gmail.com

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Abstract: *Eucalyptus* (*E. camaldulensis* and *E. globulus*) is the most widely planted exotic tree species in Ethiopia, where it is utilized for construction materials, industries, and fuel wood. From 2012 to 2013, field studies were carried out in Jimma, West Shewa, and South West Shewa Zones of Oromia regional states, focusing on agro-ecological zones to investigate diseases and pathogens associated with seedlings. Nurseries of *E. camaldulensis* and *E. globulus* located in various areas were surveyed, wherever possible at different stages of growth of seedlings. A total of 12 *Eucalyptus* spp. nurseries were surveyed across three different Oromia regional zones. Powdery mildew, damping-off, leaf spot, and wilting diseases affecting eucalyptus seedlings in nurseries were found on both eucalyptus species. During this investigation, nursery seedlings in the examined area became weakly infected and displayed visible symptoms on both *Eucalyptus* spp. *Alternaria*, *Pestalotiopsis*, *Fusarium*, *Rhizoctonia solani*, *Cylindrocladium*, *Botrytis cinerea*, *Oidium* spp and *Phoma* spp, are associated with disease symptoms. All recorded diseases vary from place to place and bed to bed depending on seedling age, seedling type, and microclimatic condition and nursery management practices. More surveys and identification of nursery diseases and inoculum sources need to be conducted in order to suggest for management procedures to produce high quality seedling in Ethiopia.

Keywords: *Eucalyptus* Seedling, Nursery, Leaf Spot, Damping-off, Powdery Mildew

1. Introduction

Eucalyptus is an exotic and most popular tree species classified in Myrtaceae family that has been extensively planted in Ethiopia. In the country, it is largely confined to the highlands (1500-3200 m.a.s.l.) where moisture and temperatures are ideal for growth. The total area under *eucalypts* plantation is now estimated to be 500,000 ha [1]. It is the most widely planted exotic species in Ethiopia. The most common *Eucalyptus* species planted in Ethiopia is *E. camaldulensis* and *E. globulus*. These two species are normally altitude-based with *E. camaldulensis* being adaptable in the upper kolla and woina dega zones while *Eucalyptus globulus* is mostly found in dega and wurch zones [8].

Eucalyptus provides a wide range of benefits for Ethiopian smallholder farmers providing that is used for fuelwood, construction materials (such as poles and stakes for construction of a house, fencing and transmission pole),

making of farm equipment, generating income with short period, production of charcoal, preventing of soil erosion, shelterbelt, drainage and windbreak for their fragmented lands [12, 1].

Currently, *Eucalyptus* is growing and expanding almost in all parts of Ethiopia for satisfying the growing demand for forest products. It is propagated by seedlings grown in nurseries by NGOs, the government, and the private sector. However, inadequate and poor quality seed supply, poor seedling quality, and inappropriate silviculture have raised constraints of forest development in Ethiopia [7].

Besides this, there are many biotic and abiotic factors that affect eucalyptus growing that has been reported worldwide. Among Biotic factors, fungal diseases are the main problem in forest regeneration that can cause heavy mortality in the nursery [11, 17]. Many fungal species viz., *Alternaria*, *Cylindrocladium* spp., *Phytophthora* spp., *Rhizoctonia solani*, *Botrytis cinerea*, *Curvularia lunata*, *Fusarium* spp., *Pythium* spp and *Puccinia psidii* have been reported from nursery seedlings of *eucalyptus* tree globally [18]. These

fungus pathogens not only cause seedling mortality but are also carried out through seedlings and become established in plantations. Diseases originating in the nursery are transported to plantation sites on infected seedlings.

Recent studies in Ethiopian Eucalyptus plantations have indicated disease problems such as stem canker caused by *Botryosphaeria*, leaf spot caused by *Phoma* spp and *Mycosphaerella* spp. were identified [2, 6]. However, little is known about disease problems to seedlings caused by fungal pathogens. Information on seedlings' diseases is critical to make decisions about diseases management and to plan preventive actions in future seedlings and plantations. Therefore, this survey presents diseases and pathogen-associated with *eucalyptus* seedlings in the nursery of Ethiopia to provide for further research and to establish diseases prevention of seedling diseases.

2. Materials and Methods

Field surveys were conducted in Jimma, West Shewa and South West Shewa Zone of Oromia regional states from 2012-2013 focusing on agro-ecological zones where forest nursery has been established. Private and government nurseries of *E. camaldulensis* and *E. globulus* located in various areas were visited, wherever possible at different stages of growth of seedlings. Occurrence of diseases, their symptoms and damage caused in the nursery beds in both bare root and polythene bag seedlings were recorded. Samples of leaves, roots and shoots with symptoms of the disease were collected and stored in a separate paper bag and transported to the laboratory for isolation. To determine the incidence of seedling disease at different Zone using the following formula

$$\text{Disease incidence} = \frac{\text{Number of diseased seedlings observed}}{\text{Total number of seedlings examined}} \times 100$$

Isolation was carried out according to species and location obtained. About two centimeters of the infected seedling leaf and root tissue were excised with a sterilized razor blade at the point of progression of disease symptom;

then surface sterilized by dipping into 70 percent ethanol solution for 2 minutes. The tissues were then rinsed in three changes of sterilized distilled water and were allowed onto PDA (potato dextrose agar) supplemented with 100 pp streptomycin to suppress bacterial growth in Petri dishes. All plates were incubated for 25 to induce fungal growth. After seven days of inoculation, fungal isolates from the Petri plates were purified by sub-culturing and pure culture was obtained.

The morphology of the culture was studied using both simple and compound binocular microscopes. Details of the fungal colony, growth rate, texture and other important characteristics were recorded for identification.

3. Result and Discussion

Because of their adaptability, rapid growth, and high value for pulp and paper, *E. camaldulensis* and *E. globulus* trees are the most extensively planted alien species in Ethiopia. A total of 12 Eucalyptus spp. nurseries suited at three different Oromia regional zones were surveyed. The survey reveals that both eucalypt nurseries had some disease problems either of minor or major importance. In the surveyed area, nursery seedlings become mildly infected and show detectable symptoms were recorded on both Eucalyptus spp during this survey. However, when out planted, these infected seedlings bring the disease into the plantation. Leaf and root diseases of *eucalyptus* seedlings have been recorded in nurseries. Diseases affecting eucalyptus seedlings in the nursery were recorded on both *eucalyptus* spp. Disease symptoms recorded during this survey include powdery mildew, damping off, leaf spot and wilting (Figure 1). Most of the diseases were prevalent in all eucalyptus nurseries surveyed. *Botrytis cinerea*, *Alternaria*, *Fusarium* spp, *Rhizoctonia solani*, *Cylindrocladium* spp, *Phythium* spp. and *Mycosphaerella* pathogens are associated with disease symptoms (Table 1). Fungal species recorded in the survey have also been recorded elsewhere in the literature as fungal pathogens affecting *eucalyptus* tree seedlings [16, 13].

Table 1. Disease and fungal associated identified during assessment.

Surveyed Zone	Host	symptoms	Associated fungi
Jimma Zone	<i>E. camaldulensis</i>	Damping off	<i>Botrytis cinerea</i>
			<i>Fusarium</i>
			<i>Rhizoctonia solani</i>
	<i>E. globulus</i>	Leaf spot	<i>Pestalotiopsis</i>
		Damping off	<i>Fusarium</i>
		Powdery mildew	<i>Odium</i> spp
West Shewa	<i>E. camaldulensis</i>		<i>Phythium</i>
		Damping off	<i>Alternaria</i> spp
			<i>Cylindrocladium</i>
	<i>E. globulus</i>	Powdery mildew	<i>Odium</i>
		Leaf spot	<i>Phoma</i> spp
			<i>Mycosphaerella</i>
South West Shewa	<i>E. camaldulensis</i>	Damping off	<i>Phythium</i> spp
		Leaf spot	<i>Alternaria</i> sp
			<i>Mycosphaerella</i> spp
	<i>E. globulus</i>	Leaf spot	<i>Phoma</i> spp
			<i>Alternaria</i> sp

Among the recorded diseases, powdery mildew and damping off are the most common and economically important diseases capable of causing seedling loss under favorable microclimatic conditions. However, in both *Eucalyptus* spp. the disease incidence and severity vary among surveyed localities depending on the microclimatic conditions, age of seedlings and nursery practices like shade management and microclimate conditions. The highest diseases incidence of powdery mildew was recorded in Jimma Zone Gobana site and West Shewa Zone Sokondo site which is 100 % and 78 % respectively compared to other diseases recorded. On infected seedlings, symptoms include white mycelium on the surface of leaf. Reduced seedling growth were observed on infected powdery mildew compared to uninfected one on seedling of both *eucalyptus* species. This clearly indicates the potential of powdery mildew causing seedling quality loss. Powdery mildew of *Eucalyptus* has also been reported earlier from different countries [15].

Damping off disease has been recorded in eucalypts nurseries raised in different localities. Seedling mortality was

found for the first 2-4 weeks after germination. The symptoms of disease manifested as a collapse of the stem tissue marked by water-soaked constricted area at the soil level causing the seedling death. On mature seedlings, the disease was manifested as yellowing of leaf and retarded growth of seedlings. The disease was common in all surveyed nurseries. However, the mortality of the seedlings varied from nursery to nursery as well as bed to bed. Mortality of the seedling can affect afforestation program. High disease incidence observed in poorly managed nursery practices. Different researchers also reported that high damping –off disease incidence was recorded on bade of dark shades, excessive watering and high seedling density [13]. Four fungi species viz.. *Botrytis cinerea*, *fusarium* spp, *phythium* sp and *Cylindrocladium* spp were isolated from root of *Eucalyptus* spp. showing damping off symptoms. Seedlings could be attacked by more than one root rot pathogen in the nursery [4, 9]. Literature indicated that *fusarium* spp. and *R. solani* have been identified as the important damping-off pathogens in forest nurseries throughout the world [14].



Figure 1. Powdery mildew and leaf spot symptoms observed on seedlings of *Eucalyptus* spp during the survey.

During the survey leaf spot and leaf blotch is other leaf diseases observed on both eucalyptus species seedlings. The diseases' symptoms appeared as leaf spots which are circular to irregular in shape and varied in size. *Phoma* spp., *Alternaria* spp, *Pestalotiopsis* and *Mycosphaerella* pathogens were associated with these leaf diseases. *Phoma* and *Mycosphaerella* leaf disease (MLD) was common on *E. globulus* trees. These pathogens are described in the literature as a pathogen of eucalyptus in the plantation [5, 6]. It is mainly severe where the altitude is high compared to low altitude, and on seedlings older

than 4-month-old and plants have water stress. Watering frequencies, shade and sowing date have an impact on nursery diseases incidence. The study of [3] also reported that *Phoma* diseases are most prevalent in cool, wet weather, light and frequent rains, fog or heavy dews and high humidity. In recent years, leaf spot disease caused by *Mycosphaerella* and *Pestalotiopsis* spp has been reported in *Eucalyptus* spp. plantation [2, 10, 18]. In general, the success of forest nurseries in raising a sufficient number of healthy disease-free planting stocks depends on nursery management practices.

4. Conclusion

E. lobulus and *E. camaldulensis* are important sources of the economy in Ethiopia. Damage in the nursery can be caused by abiotic and biotic diseases which can affect the number and quality of seedlings. The survey clearly indicated that different types of diseases damage eucalyptus seedlings in Ethiopia to differing degrees based on numerous factors such as inappropriate nursery procedures in the nursery, seedling age, and microclimate condition and management. Nurseries create an environment that is especially favorable to disease development. Different diseases were recorded in nurseries that reduce quality and number of seedling. Losses of planting stock in the nursery can severely affect the planting program. Epidemics are caused by pathogens that may originate in nearby forests or from soil, seed, or planting material introduced into the nursery. More surveys on nursery diseases and inoculum sources need to be conducted to suggest management procedures to produce high quality seedlings in Ethiopia.

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