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Disease Problems in Seed, Seedling and Plantation of *Dalbergia oliveri* Prain in Myanmar

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ဝါဝါလင်း၊ သုတေသနလက်ထောက်-၂
ဝေဝေသန်း၊ ဒုတိယညွှန်ကြားရေးမှူး (ငြိမ်း)

စာတမ်းအကျဉ်း

တမလန်းသစ်သည် သစ်၏အရောင်အသွေးလှပမှု၊ မာကြောမှုတို့ကြောင့် ကမ္ဘာတွင် ထင်ရှားလူကြိုက်များ၍ ရောင်းတမ်းဝင်တန်ဘိုးကြီး သစ်မာအုပ်စုဝင်တစ်မျိုးဖြစ်ပါသည်။ ၁၉၉၈ ခုနှစ်တွင် IUCN ကမျိုးသုဉ်းပျောက်ကွယ်တော့မည့် စာရင်းတွင် ထည့်သွင်း ထားပါသည်။ သို့သော် မြန်မာနိုင်ငံအပါအဝင် တမလန်းပေါက်ရောက်သော ဒေသတွင်း ၌လည်း ရောဂါဗေဒ အား လေ့လာထားသည်ကိုမတွေ့ရသေးပေ။ ထို့ကြောင့် ဤသုတေသန ကို ၂၀၁၆ ခုနှစ်၌ စိုက်ခင်း (၂) ခု၊ ပျိုးဥယျာဉ် (၃) ခု၌ စစ်တမ်းကောက်ယူလေ့လာခဲ့ ပါသည်။ ခါတ်ခွဲ ခန်းတွင် ရောဂါမွေးမြူ၍ မျိုးခွဲခြားခြင်း၊ လက္ခဏာများမှတ်သားခြင်း၊ ရောဂါကျရောက်မှု တွက်ချက်ခြင်း များဆောင်ရွက်ခဲ့ပါသည်။ မိုးညှင်းစိုက်ခင်း၌ သေပင် ၄၇%၊ ကသာစိုက်ခင်း တွင် ၁၈.၈၆%။ ကသာပျိုးဥယျာဉ်၌ ၆.၂%၊ ရေဆင်းပျိုးဥယျာဉ်၌ ၃.၈% တွေ့ခဲ့ရပါသည်။ ရောဂါလက္ခဏာအား ဖြင့် Necrosis၊ Tar Spot၊ Dieback၊ Yellowing တို့ကိုတွေ့ရှိမှတ်တမ်း တင်ခဲ့ ပါသည်။ ရောဂါပိုးများ အနေဖြင့် *Rhizotoniasolania*, *Cladosporiumsp.*, *Peritheciasp.*, *Pythium* sp., နှင့် *Fusariumsp.* တို့ကိုလေ့လာတွေ့ရှိခဲ့ရပါသည်။ Dieback ရောဂါသည် အများ ဆုံး ကျရောက်၍ အပင်ထိပ်ဖျား ပိုင်းများ၌ အခွံတောင်မာပိုးသားလောင်းများ ဝင်ရောက် ဖျက်ဆီး နေသည်ကို တွေ့ရှိခဲ့ရပါသည်။ ဤစာတမ်းသည် ကနဦးလေ့လာမှုဖြစ်၍ ကာကွယ် ခြင်းနည်းများဆောင်ရွက်ရန် အထောက် အကူပြုသည့် သတင်းအချက်အလက်ဖြစ်ပါသည်။

Disease Problems in Seed, Seedling and Plantation of *Dalbergia oliveri* Gamble ex Prain in Myanmar

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The Rose Wood, *Dalbergia oliveri* Gamble ex Prain is popular in the markets, very good price in furniture due to the good color and very hard. Nowadays, it is one of the CITES species as an endangered (IUCN Red List Nghia, 1998). Previously, the disease problems are not studied yet not only in Myanmar but also in the growing regions, therefore it was conducted in 2016. The objective was to study the disease problems in seed, seedling and plantation of *Dalbergia oliveri* Gamble ex Prain as a preliminary step. Five study sites were surveyed and recorded of symptoms. In the laboratory, disease isolation, identification, and disease occurrence using the formula: Disease Occurrence % = n / N x 100 (Mao, 1996). About dead trees 47.4% in Moe Nyin Tamalan Plantation, 18.86 % in the Katha Tamalan Plantation, 6.2% in Katha Nursery; and 3.8% in Yezin Nursery were found.Symptoms Necrosis, Tar Spot, Dieback, Yellowing, were observed. Pathogenicity were found *Rhizotoniasolania* in Necrosis of leaf; *Cladosporiumsp*. in Tar Spot of leaf; *R.solania, Cladosporiumsp*. in Dieback of shoot tip; *Peritheciasp*., *Pythium* sp., *Caldosporiumsp*., *R.solania*from leaf and, *Fusariumsp*. from root in Yellowing of leaf. Dieback was the most occurrencesand serious among the four common diseases and found larva of beetle borer insect infestation. This preliminary study is just information and probably to approach application treatments for future rose wood plantation.

Keywords: Disease, Pathogen, Pathogenicity, Disease occurrence, Symptom

Disease Problems in Seeds, Seedling and Plantation of *Dalbergia oliveri* Gamble ex Prain in Myanmar

1. Introduction

Myanmar is one of the mostbiodiversity hot spot in the world. There are so many species of animals and plants high number of endemic species. Famous Myanmar hard timber woods are *Tectona grandis* L.f. (Kyun), *Xyliaxylo carpa* (Roxb.) Taub (Pyinkado), *Pterocarpus macrocarpus* Kurz (Padauk), *Dalbergia oliveri* Prain (Tamalan), *Shorea siamensis* Miq (Ingyinn), and *Shorea obtusa* Wall. (Thityar). Among them, Tamalan is also one of the popular wood and endemic species in Myanmar.

Tamalan is usually can grow in primary and secondary forest, mixed deciduous forest, tropical evergreen or semi-deciduous forest, along streams, at elevations up to 1,200 metres. Its range is E.Asia, India, Myanmar, Thailand, Malaysia and Vietnam (https://pfaf.org/.../ Plant.aspx?...Dalbergia...).

Tamalanis a large deciduous tree of family fabaceae. The scientific name is *Dalbergiaoliveri*Prain and the Myanmar name is Rosewood. Mainly found in Sagaing, Mandaly, Magway Region and Kachin State. The wood of Tamalan are very good price in furniture or ornamental work due to the very good color and also the wood is very hard (R.S.Troup, *et.al.* 1921). Nowadays, Tamalan is one of the CITES species as an endangered (IUCN Red List Nghia, 1998).

Previously, the disease problems are not studied yet in other its growing region and Myanmar. Therefore, the popular species *Dalbergiaoliveri*Prain is needed to research the disease problem in Tamalan's nursery and plantation.

2. Objective

Preliminary study on the disease problems in seeds, seedling and plantation of *Dalbergia oliveri* Gamble ex Prain for baseline data.

3. Literature Review

References of the disease and pest problems of *Dalbergia oliveri* Gamble ex Prain are very rare internationally. R.S.Troup, *et.al.* 1921 described that the wood of Tamalan are very good price in furniture or ornamental work due to the very good color and also the wood is very hard. TranVan Mao. 1996 mentioned that the disease occurrence of different sites was calculated using this formula (p%= n/N x 100).

Ambrosia fungus associated with insect *Euwallacea* sp. The insect is a threat to many economically important plants in Uganda that are known to be hosts of this pest.(https://www.cambridge.org/.../core-reade...)

Aspergillus is a genus consisting of a few hundred mold species found in various climates worldwide. (https://en.wikipedia.org/wiki/Aspergillus)

Cladosporium is the most common indoor and outdoor molds. Species produce olive-green to brown or black colonies, and have dark-pigmented conidia that are formed in simple or branching chains.

Many species of *Cladosporium* are commonly found on living and dead plant material. Some species are plant pathogens, others parasitize other fungi. *Cladosporium* spores are wind-dispersed and they are often extremely abundant in outdoor air. Indoors *Cladosporium* species may grow on surfaces when moisture is present. (https://en. wikipedia.org/.../Cladosporium)

Colletotrichum includes a number of plant pathogens of major importance, causing diseases of a wide variety of woody and herbaceous plants. It has a primarily tropical and subtropical distribution, although there are some species affecting temperate crops. Description in the website that the scientific name Tamalan is *Dalbergia oliveri* Gamble ex Prain and the Myanmar name is Rosewood. (https://en.wikipedia.org/wiki/*Dalbergia oliveri*)

***Euwallacea* sp.**is a species complex consisting of three cryptic species of ambrosia beetles (Coleoptera: Curculionidae: Scolytinae: Xyleborini). *Euwallacea* breeds in various live hosts and is considered a severe pest of several economically important plants. The larvae and adults feed on a symbiotic fungus carried in a specific structure. The combination of massive numbers of beetles with the symbiotic fungus kills trees, even though the fungus alone is a weak pathogen. Adult are range between 1.9-2.5 mm long. They are dark brown or black and bear hairy. Larvae are similar to all other larvae in the family Curculionidae; legless, c-shaped and a sclerotized head capsule. (https://en.wikipedia.org/.../Euwallacea_f..)

***Euwallacea* sp.**larva lives within galleries that they mine in host trees. They vector several fungi, the fungus then infests and grows on the walls of borrows tunneled in the wood of the host trees. The larvae and adults feed on the fungus, raising a generation in about 60 days. **Economic importance**: The leaves of infested, and then infected, host trees wilt, become discolored, and may break. Weakened young, and even mature, trees may subsequently die (www.agri.huji.ac.il/mepests/.../Euwallace..).

Fusariumis soil borne filamentous fungi and economically important because many members are the causal agents of vascular wilt or root rot diseases in agricultural and ornamental crops throughout the world. (https://en.wikipedia.org/wiki/Fusarium)

IUCN Red List Nghia, 1998 mentioned that the Nowadays, Tamalan is one of the CITES species as an endangered.

Nigrosporais commonly found in air, soil, various plants, and some cereal grains.*Nigrospora* has been identified in many areas around the world; however it is most prevalent in tropical and subtropical countries. (https://en.wikipedia.org/../Nigrospora_s.)

Perithecia: a spherical, cylindrical, or flask-shaped hollow fruiting body in various ascomycetous fungi that contains the asci and usually opens by a terminal pore.

(https://www.merriam-webster.com/dictio...)

Pythium-induced root rot is a common crop disease. When the organism kills newly emerged or emerging seedlings, it is known as damping off, and is a very common problem in fields and greenhouses. This disease complex usually involves other pathogens such as *Phytophthora* and *Rhizoctonia*. *Pythium* wilt is caused by zoospore infection of older plants, leading to minor or severe wilting caused by impeded root functioning. (https://en. wikipedia.org/wiki/Pythium)

Rhizoctoniasolani is a plant pathogenic fungus with a wide host range and worldwide distribution. *R. solani* frequently exists as thread-like growth on plants or in culture, and is considered a soil-borne pathogen. *R. solani* is best known to cause various plant diseases such as collar rot, root rot, damping off,

and wire stem. *R. solani* attacks its hosts when they are in their early stages of development, such as seeds and seedlings. The pathogen is known to cause serious plant losses by attacking primarily the roots and lower stems of plants. The disease cycle of *R. solani* is important in management and control of the pathogen. (https://en.wikipedia. org/.../Rhizoctonia_s)

***Xyleborus* sp.** is a type of ambrosia beetle. It has been documented as carrying the fungus that causes a disease that can kill several tree species. The fungus grows throughout the xylem of the tree, preventing the flow of water and nutrients throughout the plant. Death can occur from four to eleven weeks after inoculation. The adult is a small, black or amber-brown, cigar-shaped beetle under two millimeters in length. The dorsal surface is mostly hairless and shiny when compared to other ambrosia beetles. (https://en.wikipedia.org/ .../Xyleborus_gl...)

4. Materials and Methods

A study on disease occurrence and the damage of Tamalan was conducted in seed, forest nurseries and plantations according to the planted areas of Myanmar. The study sites were located in different provinces such as Sagaing, Mandaly Region and Kachin State. Diagnoses of the diseases were made through the symptoms. The pathogen was identified from pure cultures and pathogenicity confirmed.

4.1 Study Sites

4.1.1 Plantations

1. Aung Bon Natagar, Katha plantation (2015-2016) one year plantation, Sagaing Region
2. TamalanTrial Plantation (2007-2008) Moe Nyin Compartment 32, Moe Nyin, Kachin State

4.1.2 Nurseries

1. Katha PhetSut Nursery, Sagaing Region
2. FRI Nursery, ZyarThri Township, Yezin
3. ShweKya Nursery, ZayarThri Township, Yezin

4.2 Study Period

October, 2016

4.3 Collection of disease samples from Plantations and Nurseries

4.3.1 Leaf Samples

0.75 %of disease samples were collected from different sites of two plantations and the disease samples of seedling were collected according to the exiting of seedlings.Symptoms and signs of all the disease samples were recorded.

4.3.2 Seed Samples

The seed 20 samples were collected from seed lab of FRI. The species were related species of *D. oliveri* Prain. such as Thinwin (*Millettia pendula* Benth), and Padauk (*Pterocarpus macrocarpus* Kurz).

4.4 Sterilization of Lab apparatus and media

Potato, Dextrose Agar boiled for the nutrient media (PDA). Then PDA media and lab apparatus were sterilized in the autoclave 120lb, for 20 minutes. Then all of cleaning Petridis were sterilized in the oven 60 C ˚temperature for 4 hours.

4.5 Laboratory Preparation and Isolation

Using the Koch's Postulate, firstly washed under the tap water to the seeds and leaves,again sterilizedby mercuric chloride (HgC12) (1.1000) g for 1 minute and then washed by double distilled water for 1 minute. Then those were isolated on the media at the laminar flow chamber.

After five to six days starting grew the mycelia on the nutrient media plate. The pure colonies were transferred into PDA nutrient test-tube.

4.6 Slide Examination

After the test-tube preparation, mycelia from all of each pathogen were spread as thin layers slides to examine under the light microscope. The characteristics of each pathogen were identified spore shapes by the fungal key book. Take pictures of respective spores by camera.

4.7 Disease Occurrence

The disease occurrence of different sites was calculated using the following formula:

Disease Occurrence % = n / N x 100 (Mao, 1996)

n = number of diseased seeds/treessamples

N = Total number of seeds/trees

5. Results

5.1 Data of Study Areas

5.1.1 Plantations

5.1.1.1 Katha Plantation (2015-2016), Sagaing Region

Average **rainfall** 2016	6 inches (152.4 mm)
Average **temperature** 2016	(Minimum11.2˚C) (Maximum 32.6˚C)
Totally **height** range of Tamalan Trees	5 inches- 2 ft 2 inches

5.1.1.2 Tamalan Trial Plantation (2007-2008), Moe Nyin, Kachin State

Average**Rainfall** 2016	5.45inches (138.43mm)
Average**Temperature** 2016	(Minimum16.2˚C) (Maximum 33.7˚C)
Totally **height** range of Tamalan Trees	3ft 2 inches- 8ft 4 inches
Totally **girth** range of Tamalan Trees	6 inches-12 inches

5.1.2 Nurseries

5.1.2.1 FRI Yezin and ShweKya

Average **Rainfall** 2016	4.3 inches(109.22 mm)
Average **Temperature** 2016	(Minimum22.03˚C) (Maximum 34.2˚C)

5.2 Symptoms and Pathogens of Plantation and Nurseries of *D. oliveri* Prain

No.	Symptoms	Pathogens				
		Plantations		Nurseries		
		Moe Nyin Plantation	Katha Plantation	Katha (Phet-Sut) Nursery	Yezin FRI Nursery	Shwe Kya Nursery
1.	Necrosis (Leaf spot)	*Rhizotoniasolania*,	none	none	none	*R.solania*,
2.	Tar Spot	*Cladosporium* sp., *Mycelium*	none	*Cladosporium* sp.	none	none
3.	Dieback	*R. solania* *Cladosporium* sp.,	*R.solania*	*R.solania* *Cladosporium* sp.,	*R.solania* *Cladosporium* sp.,	*R.solania* *Cladosporium* sp.,
4.	Yellowing	Unknown spore Perithecia (Ascus)	*Pythium* sp., *Caldosporium* sp.	*R.solania*	*R.solania* (Leaf, Tip), *Fusarium* sp. (Root)	*R. solania*

5.2.1 Necrosis (leaf spot)

Symptoms: Early symptom of this disease is the appearance of small brown spots. As the spots enlarge later, they become small circle in shape and develop a yellow halo. Later, spots develop gray centers with a darker, reddish brown border. During the early part of the growing season, leaf spots are inconspicuous, but after bloom, the spots enlarge rapidlyand may cause death of the leaf from the tip back. Premature killing of the leaves may weaken the underground plant parts and gradual death of the entire plant.

Pathogen: *R. solania*

Necrosis (leaf spot) symptom

Pure culture of pathogen

R.solania

Figure 1: Symptom and Pathogenof Necrosis (leaf spot)

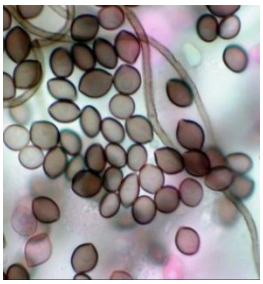
5.2.2 Tar spot

Symptoms: These spots appear on tree leaves. These develop into brown-black lesions, retaining the yellow border.The lesions continue to grow, form leaf spots that look like tar.The tar spot can grow up to 0.1-0.3 cm in diameter.

Pathogen: ***Cladosporium*** sp.,

Tar spot symptom

Pure culture of pathogen



Cladosporium sp.,

Figure 2. Symptom and Pathogen of Tar Spot

5.2.3 Die back

Die back of *R. solania* and *Cladosporium* sp., were observed in Moe Nyin (2007-2008) plantation, Katha plantation (2015-2016), Katha PhetSut Nursery, FRI nursery (Yezin) and Shwe Kya Nursery. The larvae of insect pest were found inside of the some branch from the Moe Nyin plantation and the beetle adult were found from the dead stem of the some seedling of FRI nursery (Yezin). The larva is C shaped, creamy color and no legs, size is 5-7mm length and 3-4 width. The adult is very small, hairy; size is 1mm and dark brown color.

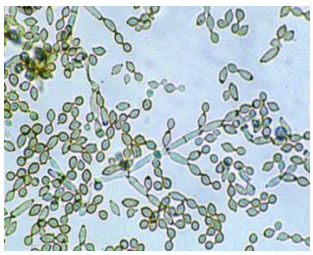
Symptoms: The branches on top of the tree start dying to downwards. Gradually the infection spread to main stem killing outright.

Pathogen: *R.solania*and *Cladosporium* sp.

Die back symptom (Plantation)

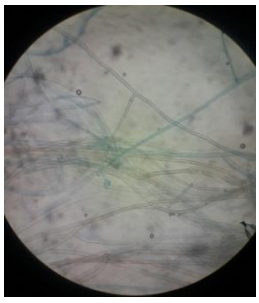
Die back symptom (Nursery)

Pure culture of pathogen



Cladosporium sp.

Pure culture of pathogen



R.solania

Figure 3. Symptoms and Pathogens of Die back

Larva is inside of the branch

Larva of Shoot borer
Euwallacea sp.

Adult
Euwallacea sp. (Beetle)

Figure 4. Larva and Adult (Beetle)

5.2.4 Yellowing (Chlorosis)

Yellowing of unknown sporebut, ascus Perithecia were observed from Moe Nyin plantation. *Pythium* sp.,and *Cladosporium* sp. were found from Katha plantation. *R. solania* was observed fromKatha Phet Sut nursery, FRI nursery, and Shwe Kya Nursery. *Fusarium* sp., was found from the FRI nursery (Yezin).

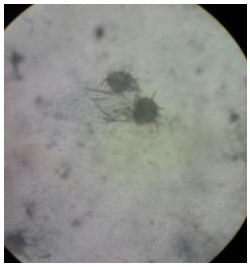
Symptoms: Chlorosis –Yellowing of leaves is called chlorosis due to insufficient of chlorophyll.

Pathogen: unknown spore Perithecia, *R. solania* and *Cladosporium* sp., *Fusarium* sp. (Root), *Pythium* sp.,

Yellowing symptom of nursery

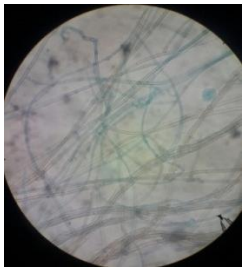
Yellowing symptom of plantation

Pure culture of pathogen



unknown spore Perithecia(Ascus)

Pure culture of pathogen



R. solania (Leaf, Tip),

Pure culture of pathogen

Caldosporium sp.

Pure culture of pathogen

Fusarium sp. (Root).

Pure culture of pathogen

Pythium sp.,

Figure 5. Symptoms and Pathogens of Yellowing

5.3 Disease Occurrence from Nurseries and Plantations

Four disease symptoms were observed from this experiment (Necrosis, Tar spot, Dieback and Yellowing). Moe Nyin plantation found all disease symptoms. Among them, Dieback is most significantly all of these diseases. However, Katha plantation found only two diseases symptoms (Dieback and Yellowing). Necrosis, Tar spot were not found. In nurseries, Necrosis, Dieback and Yellowing for Shwe Kya, Dieback and Yellowing for FRI, Tar spot, Dieback and Yellowing for

Phet Sut were observed respectively. All of these three nurseries, Dieback was observed in FRI interestingly and alsoYellowing was found in Phet Sut significantly.

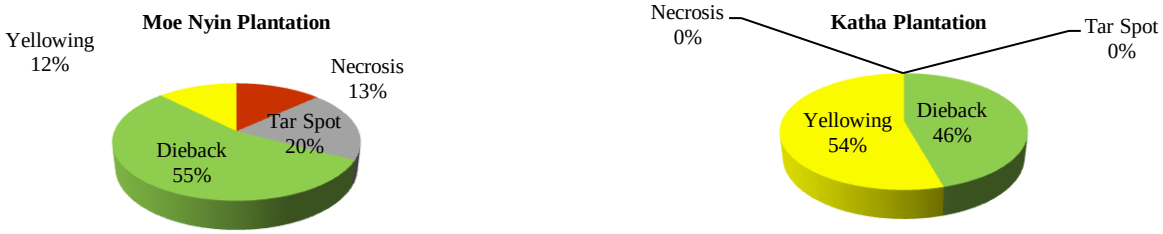


Figure 6. Moe Nyin and Katha Plantations

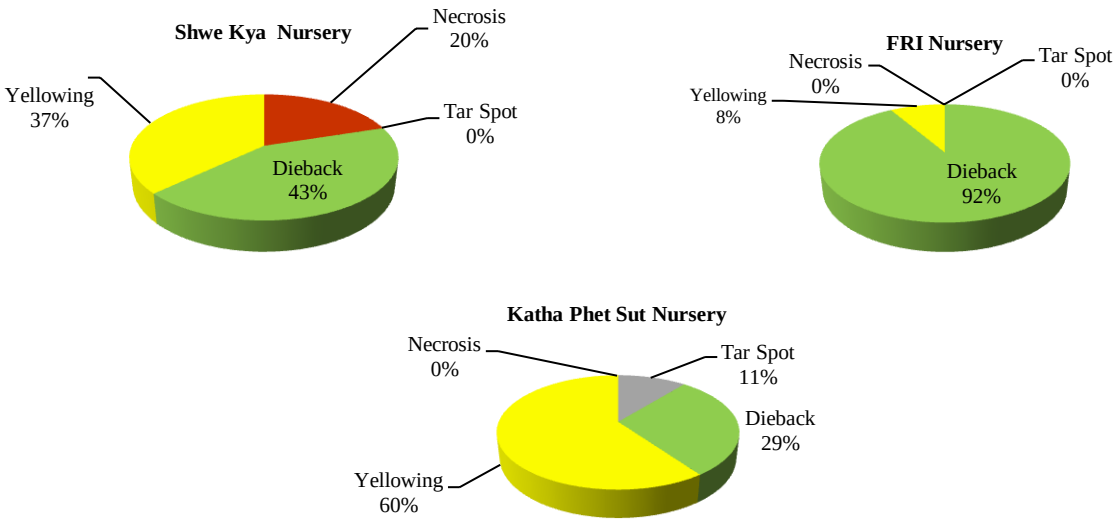


Figure 7. Shwe Kya, FRI and Katha Nurseries

5.4 Seed Test and Pathogens

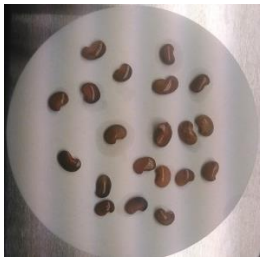
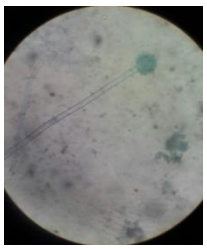
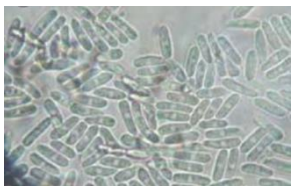


Figure 8. Seed test in the laboratory

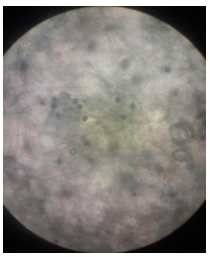
No.	Seed	Pathogens
1.	*D. oliveri*Prain (Tamalan)	*Nigrospora* sp., *R.solania*
2.	*Millettia pendula*Benth (Thinn Winn)	*Aspergillus*sp., *R.solania*
3.	*Pterocarpus macrocarpus* Kurz (Padauk)	*Colletotrichum* sp., *R.solania*



*Aspergillus*sp.



Colletotrichum sp.



Nigrospora sp.

Rhizotoniasolania

Figure 9. Seed test in the laboratory

6. Discussion

The paper has paid attention on various diseases affecting the nursery, and plantation-ground trees. One disease was serious such as dieback, which is needed to be controlled effectively to minimize losses. Dieback is caused by many fungi and a few bacteria that produce cankers, anthracnose, wilts, and stem or root rots. It also caused by nematodes, stem- or root-boring insects, winter injury, and a deficiency or excess of moisture or an essential element may cause dieback, directly or indirectly (https://www.britannica.com/.../dieback).

In this study, four symptoms were observed: Necrosis, Tar Spot, Dieback, and Yellowing.Dieback is caused by many fungi and a few bacteria that produce cankers, wilts, and stem or root rots. It also caused by nematodes, stem- or root-boring insects. (https://www. britannica.com/.../dieback).

In this experiment, dieback was found with bored insect beetle belonging to family Curuclionida and Scolytidae. Dieback was more obvious than others diseases, although the two plantations were difference by the age, and the locality. It could be mentioned that dieback was a serious and common in the Tamalan plantation.

Myanmar is a tropical country with warm and humid climate and cold during winter in northern region. The data rainfall average from 5.45 inches (138.43 mm); temperature 16.2 ˚C to 33.7 ˚C in the plantation of northern and rainfall average 4.3 inches (109.22 mm); temperature 22.03˚C to 34.2˚C in the nurseries of middle part of Myanmar were recorded. In the study areas, Dieback was observed in different climatic condition (cold, warm, high and low rainfall)

This paper report the results of a disease survey conducted in some areas of Myanmar. Tamalan nursery and plantation are very few in Myanmar planted. Therefore, data collection was limited to these regions.Soil test should be studied for plantation and apply the fertilizer when it was young stage.Through literature review information of disease problems in this species is very less in Tamalan. This study will support as preliminary information to planted regions.

According to the literature, Ambrosia fungus associated with insect *Euwallacea* sp. and *Xyleborus* sp..The insect is a threat to many economically important plants. Therefore, the Dieback of Tamalan was infected with fungi also ambrosia insectscan be confirmed.

Yellowing (Chlorosis) was common symptom, but it can effect on the photosynthesis,consequently, to growth loss of tree. Yellowing may cause by virus, bacteria and fungi and also caused due to mineral deficiency as iron, manganese, zinc, etc.(Dr. Shambhu Kumar, Dr. G.E. MallikarjunaSwamy, Dr. C. Gokulapalan. 3-25.Sept.2018.Training on Techniques in Plant Pathology).

Tar spot and necrosis leaf diseases were observed as few as in the nursery and plantation. Tar spot was noticed that more found in the cold region.

Nigrospora sp., *R. solania*, *Aspergillus*sp. and *Colletotrichum* sp. are soli borne pathogens. Those were found in seeds testing. Therefore, seeds should be sterilized before planting.

Mostly, *Fusarium*and *R. solani* attacks in their early stages of development, such as seeds, seedlings and young plantation. (https://en.wikipedia.org/.../Rhizoctonia_s...)

Pest and disease control is important in forest activities. This paper reported only the results of a disease survey conducted in Tamalan planted area of Myanmar. Tamalan nursery and plantation are very few numbers in Myanmar. Therefore, data collection was limited; statistical data analysis could not be done.

Information of disease problems in this species Tamalan was also not found in the other regions for literature review. This started study can support as preliminary information to planted regions.

7. Conclusion

This paper resulted in the appearance of a number of diseases in seeds, nurseries, and plantations of Tamalan. High occurrence of disease dieback occurs in the Tamalan. About dead trees 47.4% in Moe NyinTamalan Plantation, 18.86 % in the Katha Tamalan Plantation, 6.2% in Katha Nursery; and 3.8% in Yezin Nursery were found. It showed the species were no resistance in manmade except may be natural growing. However, so many factors such as soil, location, weather, and treatments etc. may be considered before planting.

Recently, the species would be kept as an essential species to hard wood group and causes of popular species in the list of endangered. Nursery and plantation of Tamalan establishment would be implemented successfully in Myanmar, consequently silvicultural & tree improvement techniques, disease and pest management, adaptable soiland climatic conditions will be considered integrated with academic experts for several factors.

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7. ဦးမန်းကိုကိုကြီး နှင့် ဦးဇော်ဝင်း (၁၉၈၅)၊ ပဲခူးရိုးမတွင် စီးပွားရေးအရ အဖိုးတန် သစ်မျိုးများစမ်းသပ်စိုက်ပျိုးခြင်း။ Trial Planting of Commercial Sp. in the East Pegu Yoma. သစ်တောသုတေသနဌာန။

8. သစ်တောရေးရာဝန်ကြီးဌာန၊ (၂၀၀၆ ခုနှစ်၊ စက်တင်ဘာလ)၊ ဒေသအလိုက် သစ်မျိုးစုံ စိုက်ခင်းများတည်ထောင်ရေးစီမံချက်။ သစ်တောဦးစီးဌာန။

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