



Seasonal incidence of Major diseases of 'Kendu' Plants (*Diospyros melanoxylon* Roxb.) and their management

Sagarika Parida

Department of Botany, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India

Abstract

The aim of this work was to study on seasonal incidence and extent of yield loss by various diseases of kendu plants and evaluation of selected biodegradable fungicides against major diseases. Field surveys were conducted in six districts namely Dhenkanal, Angul, Sambalpur, Sonepur, Phulbani and Nayagarh covering 8 blocks for documentation of major diseases of kendu plants and for assessing the magnitude of the damage they cause. In addition to these regular surveys at 7-14 days interval were conducted in the kendu research farm located at Bhagbanpur, Dhenkanal. Four fungal diseases viz., leaf spot, black mold, leaf blight and twig blight were recorded in kendu growing areas of Dhenkanal which make the leaves unsuitable for its economic value and thereby reduce the revenue collection of the state. This study was focused on management of different fungal diseases associated with the juvenile leaves of kendu plant rather than the causal organisms. From this investigation, it was concluded that Indofil M-45(0.25%) was found to be the most effective to control leaf spot disease. Leaf blight was controlled by Bavistin (0.15%) followed by Mopsin M-70 WP (0.15%) of about 69.1% and 48.7% disease incidence respectively. Coppicing was found to be the most effective practice to protect the plants from different prevalent diseases. Four fungal diseases viz., leaf spot, black mold, leaf blight and twig blight were also controlled significantly by the innovating cultivation practices like double coppicing.

Keywords: Diospyro, biodegradable fungicides, kendu plants, leaf spot; seasonal incidence

1. Introduction

The importance of forests and forest products having both direct and indirect effect on the growth and development of national economy have been increasingly realised in recent years. The Kendu plant is commonly known as Malabar ebony in English and Tinduka in Sanskrit. *Diospyros melanoxylon* Roxb. (Ebenaceae) is one of the most important forest plants in India. Its name of the genus is derived from the Greek word 'Dios' meaning divine and 'pyros' meaning is fruit, reflecting to the exceptional fruit and the species name in Greek is dark wood. For the first time it was reported that the fruit of kenduis low glycemic along with anti-oxidative stress properties ^[1]. The economic significance of this plant lies in the tender leaves commonly used for bidi wrapping. Kendu leaves are much superior and widely preferred for bidi wrapping because of their peculiar aroma, hygrosopic nature, fine texture, burning quality, storing capacity, low cost and easy availability.

Kendu plants are widely growing in tropical dry and moist deciduous forests to semi evergreen and sub-tropical sal forest ecosystem. In India it is widely grown in Madhya Pradesh, Odisha, West Bengal, Maharashtra, Gujarat, Rajasthan, Tamil Nadu and parts of Karnataka, Andhra Pradesh, and Uttar Pradesh. After nationalisation of Kendu trade in 1973, its cultivation in Odisha gained momentum. Odisha is the second major producer of kendu leaves sharing about 17 per cent of the total production, first being Madhya Pradesh and the sale price has gone more than Rs. 100crores per annum. Leaves of *D. melanoxylon* possess extraordinary qualities of flavour, colour, flexible and leathery texture, decay resistance which make the leaves suitable for wrapping bidis.

One of the major limiting factors of kendu leaf production is the devastation caused by insect pests and diseases. *Sterum lobatum* responsible for causing white spongy rot in timber and leaf spot is caused by *Cercospora kaki* ^[2]. In spite of importance of kendu plants no systematic studies were conducted in Odisha. In this study a survey was conducted on seasonal incidence and extent of yield loss by various diseases of kendu plants and evaluation of selected biodegradable fungicides against major diseases. *D. melanoxylon* Roxb. (ver: Kendu) (Ebenaceae), also known as coromandel ebony persimmon, is an endemic plant of India and the most economically important species of *Diospyros* ^[3]. *D. Melanoxylon* leaves have been extensively used in Indian traditional medicine as diuretic, styptic, laxative, carminative and to cure night blindness and to improve the eye sight ^[4]. The leaf paste with Madhuca fruit and *Adina cordifolia* leaves is used by local people to cure loose motion, leaf juice is used for piles and also used as anti-emetic, scabies, night blind ness ^[5]. Fruit pulp is also used to check loose motion. Leaf and dried flowers used in treating in dyspepsia and diarrhoea. Leaf powders with roots of *Gardenia turgida* and *Tephrosia purpurea* is used to treat gonorrhoea ^[6]. Barks, leaves and fruits are used in treatment of malaria, labour pain ^[7].

Phytochemical study revealed that the leaves of *Diospyros melanoxylon* contain alkaloids, carbohydrates, flavonoids, aminoacids, glycolysis, tannins, proteins, steroids and saponins. No much work has been done on isolation of phytoconstituents from kendu leaves therefore in future many active chemicals may be isolated from this plant and may serve as the resource to treat various diseases. As different diseases have impact on the plants as plants remain in mild stress condition during infections by various

pathogens, therefore it may have impact on various bioactive compounds. It is also reported that leaves contain alpha-amyrin, ursolic, corsolic acid [8]. Commercially, the coppiced leaves are highly valued for their use as wrappers in the bidi (cigarette) industry [9]. The kendu leaf trade is an important socioeconomic activity of tribals of India, especially of the states of Orissa, Madhya Pradesh and Andhra Pradesh, and this is a good source of revenue for the Government [10]. Matured fruits before ripening are used for relieving flatulence and after ripening are useful to check excessive bile secretion [11]. Fruit extracts reduce fistula problem, against rheumatoid arthritis, reduce abdominal pain and also used as skin care essentials. As no scientific data is available for the management of diseases of kendu plants, therefore this study was carried out from 2014 to 2016 to evaluate the major disease incidence and their management with suitable fungicides with due permission of forest department of Orissa.

2. Materials and Methods

2.1 Experimental site

Field surveys were conducted in six revenue districts namely Dhenkanal, Angul, Sambalpur, Sonapur, Phulbani and Nayagarh covering 8 blocks for recording the arthropod pests and diseases of kendu plants and for assessing the magnitude of the damage they cause. In addition to these regular surveys at 7-14 days interval were conducted in the Kendu Research Farm located at Bhagbanpur, Dhenkanal. The details of survey locations are depicted in Table 1.

2.2 Methodologies adopted

At regular intervals observations were recorded from 10 plants selected randomly at each location. The leaf/plant samples collected at each day of observation were examined for the presence of diseases and were preserved in a disease herbarium for future reference. The microscopic examination of the diseased samples was made for the presence of pathogens associated with it. Besides, infected leaf samples, after surface disinfection, were kept in moist chamber and isolated in potato dextrose agar (PDA) media. The growth of the pathogen was periodically absorbed and finally examined under the microscope. Based on the disease scoring, the percentage disease intensity (PDI) was calculated by using the following formula:

1. $PDI = \frac{\text{Sum of all disease ratings}}{\text{No. of leaves examined}} \times 100$
2. Maximum disease score X No. Of leaves examined

2.3 Statistical analysis

The data was subjected to statistical analysis using ANOVA to find out the differences between different fungicides to treat leaf spot and leaf blight diseases of kendu plants

3. Results and Discussion

3.1 Major Diseases of kendu plants

Four fungal diseases viz., leaf spot, black mold, leaf blight and twig blight were recorded in different kendu growing areas of Dhenkanal, Angul and Sambalpur districts. A great regional variation in intensity of these diseases was observed. The experimental work to find out the effective fungicide and impact of coppicing on yield was later on confined to Bhagbanpur kendu farm, Dhenkanal. The symptoms and intensities of these diseases were described below.

3.1.1 Leaf spot

Minute dark brown necrotic spots developed on the leaf surface which gradually enlarged in size and became circular to oval or irregularly circular in shape with greyish white centre. In severe case they coalesce forming large lesions on the leaves. Back side of the leaf, just corresponding with the spots also looked dark brown to black colour (Fig. 1 & 2). Microscopic examination of the diseased tissues revealed the presence of conidia of *Cercospora kaki* species. The disease was very common in all the places and was maximum at Angul with 35.8% and minimum at Dhenkanal with 30.6% incidence.

3.1.2 Black mold

Black filmy or cottony mycelia growth was observed on the under surface of the leaves. The upper surface of the corresponding area of the leaves looked slightly dark. The causal organism isolated is *Cladosporium* spp. The disease intensity was highest with 63.65% mean leaf infection (MLI) at Angul (Table 3). October was the most favourable month for black mold disease while minimum intensity was recorded with 6.7% in May (Table 4).

3.1.3 Leaf blight

Blightening or burning symptoms appeared in the leaf tips which gradually progressed downward covering maximum portion of the leaf blade. Dark coloured patches were observed in the margin and upper surface of the leaf (Fig. 3). The disease was found to be caused by *Alternaria* species. The disease intensity was maximum with 26.65% at Dhenkanal and minimum of 14.9% at Sambalpur (Table 3). Leaf blight incidence was maximum (20.1%) in October and minimum (3.5%) in August (Table 4). ANOVA test revealed highly significant at $p < 0.05$ with p -value < 0.00001 .

3.1.4 Twig blight

The apical portions of the stem and branches were blighted showing dark or dark brown necrotic zones surrounding the young and old twigs and ultimately arrested the vegetative growth of the plant. The disease was first recorded at Sambalpur, and subsequently from other survey locations. *Alternaria* spp. was isolated from the twig. The disease intensity was maximum with 26.75% leaf damage at Sambalpur and minimum of 7.75% at Angul (Table 3). The intensity of twig blight was very mild throughout the year maximum being 5.0% in the month of February and minimum of 2.1% in the month of December.

It was also noticed that the incidence of twig blight started very late in the season, generally in the month of December (Table 4). The average disease intensity was calculated during each month and found that all the foliar diseases remained severe from September to November and then gradually declined in the subsequent months. Rainfall also played a major role and from June the incidence of the disease gradually increased. It was maximum of 32.8% in October and minimum of 20.3% during February of the next season (Fig. 4).

3.2 Innovative Cultural Management for Major Diseases of Kendu Plants

3.2.1 Cultural practices/Coppicing

For the management of diseases of kendu plant, one of the major cultural practices is coppicing of the plant at the

appropriate time. Based on past experience coppicing of kendu plants is normally initiated from early February. In this operation plants are cut from the ground level every year. This operation continues for a period of about one month. The coppiced plants put forth new sprouts in a course in a course of about 3-4 weeks and leaves from these plants are harvested around 7-8 weeks after coppicing. This operation is essential for better quality and more quantity of leaf and to minimise both the pest and disease incidence, provided it is done at the right time.

3.2.2 Clean cultivation

It is an important operation for ensuring better quality of leaves as well as more harvest from the kendu growing areas. Normally at the time of coppicing the unwanted plants in the vicinity of kendu plants are cleaned, either by cutting or uprooting with sharp implement. This operation helps to minimize the pest incidence as several plant species serves as alternate hosts for many insect pests and diseases. Besides, kendu plants get better nutrition in the absence of other plants in its vicinity.

3.2.3 Effect of coppicing on the incidence of diseases

After coppicing sequential observations were taken from newly sprouted kendu plants. Three sets of observations were recorded from the time of sprouting upto leaf plucking stage. In the fresh and tender leaves, developed from the coppiced plants, the incidence of the disease was in very low intensity compared to older plants as mentioned earlier. The leaves were completely free from the disease in the 1st set of observations recorded during the last week of March. Most of the above diseases gradually developed subsequently increasing their intensity up to the plucking stage of the leaves.

In double coppiced plants the leaf spot, leaf blight and twig blight disease varied from 2.5 -3.0, 2.5- 4.0 and 3.5 -5.0% respectively (Table 5) in 2nd and 3rd sets of observations recorded up to April last week. Black mold disease was not observed during this period. The low intensity of these diseases has little effect in deteriorating the quality of the leaves and economic value of the plant.

3.3 Evaluation of selective fungicide against the major diseases of kendu plants

In order to evaluate the efficacy of fungicide against the leaf spot and leaf blight diseases of kendu plants five chemicals were sprayed during October to the newly sprouted plants coppiced in the month of September. Observations on the disease incidence were recorded at 21 days after spraying. The results revealed that Indofil M-45 (0.25%) was most effective in controlling the leaf spot disease and was followed by Thiram (0.25%) and Bavistin (0.15%) which could bring out 67.7 and 65.8% disease control respectively. Similarly, leaf blight disease was effectively controlled (69.1%) by Bavistin (0.15%) followed by Mopsin M-70 WP (0.15%) and Indofil M-45(0.25%) which resulted 48.7 and 39.0% disease control respectively. In untreated check the leaf spot and leaf blight disease intensities were maximum of 155 and 12.3% respectively. ANOVA revealed significant differences in controlling kendu leaf diseases (p -value = 0.004508) and was found to be significant at $p < 0.05$.

From Table 7, it was observed that double coppiced plants showed very less or no leaf infection in comparison to

control plants. In Angul area, leaf spot, black mold, leaf blight and twig blight were not observed in double coppiced plants and only twig blight was reported with only MLF of 2.3 %. Double coppicing was also found to reduce the mean leaf infection in both Dhenkanal and Sambalpur district where no black mold disease was reported. Leaf spot, leaf blight and twig blight was also observed with very less % of leaf infection in contrast to control plants. It was reported that both quantity and quality production of kendu leaves can be enhanced with an average of 435800 leaves/ha with proper silvicultural management like coppicing without injury which showed significant effect on quantity, quality and uniformity aspects ^[12]. Four fungal diseases viz., leaf spot, black mold, leaf blight and twig blight were recorded in different kendu growing areas of Dhenkanal, Angul and Sambalpur districts. Incidence of leaf spot was found to be maximum of 32.8% in October and minimum of 20.3% during February of the next season. October was the most favourable month for black mold disease while minimum intensity was recorded with 6.7% in May. Leaf blight incidence was maximum (20.1%) in October and minimum in (3.5%) in August. The intensity of twig blight was very mild throughout the year maximum being 5.0% in the month of February and minimum of 2.1% in the month of December. As kendu plant is one of the revenue crops of Odisha, therefore, disease management practices were done. From this study it was concluded that Indofil M-45(0.25%) was found to be the most effective to control leaf spot disease. Leaf blight was controlled by Bavistin (0.15%) followed by Mopsin M-70 WP (0.15%) controlling about 69.1% and 48.7% disease incidence respectively.

Table 1: Survey locations in Odisha

Sl. No.	Survey locations		
	District	Block	Village
1.	Angul	Meramundali	Meramundali
2.	Dhenkanal	Dhenkanal	Bhagabanpur
			Kuanriapal
			Gundichapada
			Pudapada
3.	Nayagarh	Nayagarh	Kutabari
4.	Phulbani	Chakapad	Charichhak
5.	Sambalpur	Redhakhol	Redhakhol
		Jujumara	Jujumara Charmal
6.	Sonepur	Sonepur	Hangupur

Table 2: Disease scoring scale

Scale	Parameter
0	0% leaf area damage
1	1% leaf area damage
2	5% leaf area damage
3	5-25 % leaf area damage
4	25-50% leaf area damage
5	More than 50% leaf area damage

Table 3: Disease incidence in kendu Plants

Mean Leaf Infection (MLF, %)				
District	Leaf Spot	Black mold	Leaf Blight	Twig Blight
Angul	35.8	31.75	22.55	7.75
Dhenkanal	30.6	41.05	26.65	11.25
Sambalpur	31.45	63.65	14.9	26.75

(Mean of 10 observations recorded at each location)

Table 4: Incidence of major kendu plant diseases during different months

Percentage of Incidence				
Month	Leaf Spot	Black Mold	Leaf Blight	Twig Blight
August	23.2	12.0	3.5	0
September	30.5	15.6	10.3	0
October	32.8	20.5	20.1	0
November	27.2	17.3	18.5	0
December	25.3	13.4	17.0	2.1
January	22.5	10.3	16.3	3.2
February	20.3	8.1	15.4	5.0
March	20.2	8.2	17.2	3.1
April	20.7	7.3	16.8	2.4
May	24.6	6.7	14.4	0
June	28.3	8.5	13.8	0

p- Value= < 0.00001 and significant at *p*<0.05.

Table 5: Disease incidence in double coppiced kendu plants in Dhenkanal kendu farm

Mean Leaf Infection (MLF, %)				
Set	Leaf Spot	Black mold	Leaf Blight	Twig Blight
1 st set	0	0	0	2.3
2 nd set	2.5	0	2.5	3.5
3 rd set	3.0	0	4.0	5.0

Mean of 10 observations recorded at each location

Table 6: Evaluation of selective insecticides against major diseases of kendu plants

Mean Leaf Infection (MLF, %)					
Fungicide	Conc. (%)	Leaf spot (%)	Extent of control (%)	Leaf Blight (%)	Extent of control (%)
Bavistin	0.15	5.3	65.8	3.8	69.1
Indofil M-45	0.25	3.5	77.4	7.5	39.0
Sutox	0.25	10.3	33.5	11.5	6.5
Mopsin 70WP	0.15	8.3	46.45	6.3	48.7
Thiram	0.25	5.0	67.7	9.5	22.7
Control	0	15.5	0	12.3	0

p- Value= 0.004508

Table 7: Comparative Disease Incidence in control and double coppiced Kendu Plants

Mean Leaf Infection (MLF, %)						
District						
Diseases	Angul		Dhenkanal		Sambalpur	
	Control	Double coppiced	Control	Double coppiced	Control	Double coppiced
Leaf Spot	35.8*	0	30.6	2.5	31.45	3.0
Black mold	31.75	0	41.05	0	63.65	0
Leaf Blight	22.55	0	26.65	2.5	14.9	4.0
Twig Blight	7.75	2.3	11.25	3.5	26.75	5.0

*Mean of 10 observations recorded at each location



Fig 1: Leaf spot disease (Adxial surface)



Fig 2: Leaf spot disease (Abxial surface)



Fig 3: Leaf blight disease

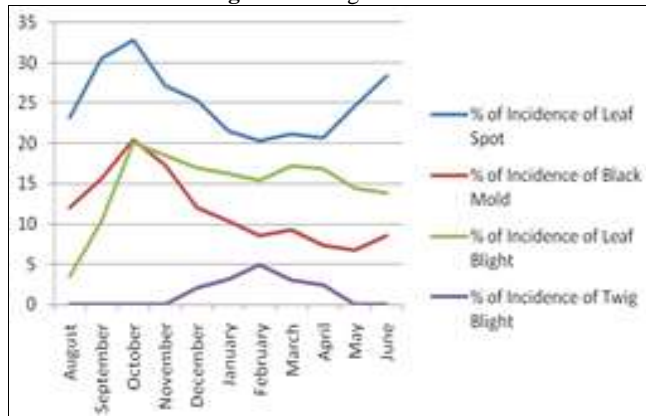


Fig 4: Disease incidence in different months

4. Conclusion

The forecasting observations indicated that the major foliar diseases of kendu plants started appearing in April-May and gradually got intensified during January-February before next season coppicing. As the coppicing practice removes the sources of infection and the pathogen takes quite a long time for multiplication, therefore in order to protect the juvenile plants from various diseases, the cut twigs should be kept far away or burnt to protect the next season plants. Because of the weather parameters prevailing during March to May, which being the peak period for plucking of leaves, do not favour the multiplication of pathogens and development of the diseases in the plants. Consequently, the juvenile kendu leaves escape from the incidence to a great extent.

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