Sissoo dieback: its cause and effect on plantation management

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Over the past few years, sissoo (*Dalbergia sissoo*) - a widely planted species in Nepal's Terai and inner Terai is suffering from dieback disease. The research conducted to identify its major causes and effect on plantation management through out sissoo growing areas of the country has showed that average dead and dying trees were 6.4percent and 9.2percent respectively. A loss of about 5000 million NRs (10 million from private plantation), has been estimated. The effects of dieback was less in places where quality seed and planting materials alongwith proper silvicultural practices have been used. Insects were not found to be the major cause of the dieback where as *Fusarium* species, mostly *F. solani* were the most common pathogens.

Use of quality seed sources, genetic materials, mixed plantation, proper silviculture management and site-species matching are the prerequisite for preventing sissoo dieback. However, removal of dead and dying trees, use of insecticides such as Metasystox, Roger and Bordeaux Paste are curative measures.

Keywords : *Dalbergia sissoo*, plantation, insect-pest, *Fusarium* species, Terai, Nepal

Sissoo *(Dalbergia sissoo)* is a widely planted species in Nepal. It has received the highest priority for plantation in the recent past by Government agencies and private tree growers especially in the lowlands (Joshi, 1994; White, 1990). Gautam (1996) estimated around 90 percent of plantations in Nepal's Terai were covered by this species. Unfortunately, the plantations have been suffering from a serious dieback disease over the past few years (Parajuli *et al.* 1999; FORESC, 1998).

The present study has been conducted by the Department of Forest Research and Survey (DFRS) to identify the major causes of sissoo dieback and its effect on sissoo plantation areas of the Terai and inner Terai of the country.

Methodology

A research team comprising forestry professionals, socio-economist, soil scientists, entomologist and pathologist were involved to conducted the present study.

In the first stage, a general survey was conducted in 24 districts of the Terai and inner Terai to estimate the extent of damage of sissoo. In the next stage, intensive survey was conducted in seven districts to obtain information on the relationship between sissoo dieback and sissoo stand dynamics. Focus was given to edaphic, entomological, pathological and silvicultural factors. In addition, socio-economic study was carried out to evaluate the impact of dieback on the local as well as national economy. Similarly, survey of Breeding Seed Orchards (BSO) and other sissoo plantation was conducted to identify the effect of seed source, genetic materials and silvicultural management on sissoo dieback.

Formal and informal discussion, key informant interviews, group discussions and transact surveys were the source of information for the present study.

Results and discussions

Socio-economic survey

Sissoo has been planted at almost all districts surveyed. However, these days farmers are looking for alternative such as Bakaino (*Melia azederach*), Kadam (*Anthocephalus cadamba*), and Poplar (*Populus* sp), etc.

Socio-economic study revealed a positive correlation between landholdings and private sissoo plantation in all the three districts studied. Similarly, a correlation was observed between the income level of the household and sissoo growing in all the three districts (r=0.226 in Kanchanpur, 0.020 in Chitwan and 0.108 in Sunsari). This

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implies that the wealthy people have done more plantation than others.

Hence, the impact of sissoo dieback is higher among low income groups and small landholders.

Market behaviour and economic loss due to dieback

The present study revealed that a greater flow of low quality sissoo timber has lowered the price of farm grown sissoo, which is due to the low proportion of heartwood and low outturn of sawlog. However, the prices for natural sissoo have remained almost constant over the last five years. Based on the information obtained from sissoo growers and saw mill owners, the price trend of sissoo is presented in Table 1.

Table 1: Trend of market price of sissoo

Price/cft (NRs)	Kanchanpur	Chitwa n	Sunsari	Average
In 1994	420	508	480	469
In 2000	200	287	220	236

A loss of about 5000 million NRs has been estimated due to dieback, of which private plantations contribute 510 million.

Sissoo dieback in natural forests and plantations

The total area of sissoo plantations (Government and Community) in 24 Terai and inner Terai districts was 49,401 ha, (24,461 ha for national forest, 22958 ha for community forest and 1981 ha for private land). The percentage of sissoo population under different ownership is given in figure 1.

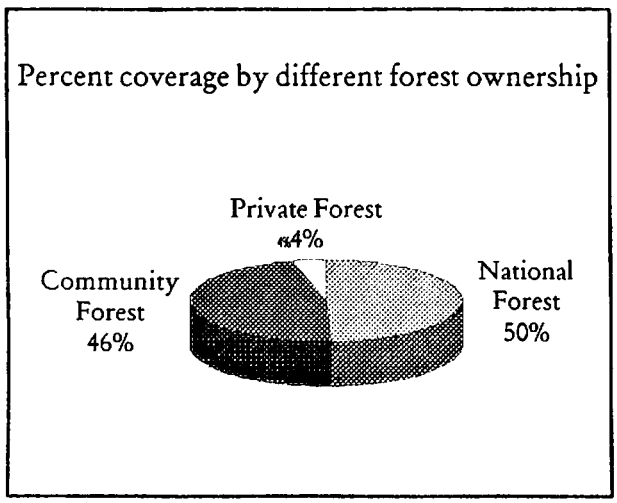

Figure 1 : Percentages of sissoo area under various ownerships

Stocking survival percenatge, dead and dying tree per hectare, dead and dying percentages of all community and government plantations of 24 districts are provided in appendix 1. The highest proportion of dead trees recorded was 14.6 percent in Siraha District followed by 13.5 percent in Jhapa (Appendix 1 and Figure 2). The highest proportion of dying trees 26.4 percent was in Bara District followed by 25 percent in Makawanpur. The overall percentages of dead and dying trees were 6.4 percent and 9.2 percent respectively. The lowest proportion of dead trees (1.2 percent) was found in Sindhuli followed by 1.4 percent in Parsa. Stands of sissoo at the Central and Western regions had higher proportions of dying trees than at the Eastern, Mid and Far Western regions. The proportion of dead and dying trees in all of the six districts of Mid and Far western regions was less than five percent.

The dead trees (10 percent) in the eastern districts (except Udayapur) was higher than the dying 2 percent. The could be due to the non-removal of dead trees, especially in government plantations or inclusion of dead stumps as dead trees during the survey. Less than 2 percent of dying trees in these districts may indicate a lower effect of dieback in the past year (2055/56 or 1999/2000). This result coincides with general observations made by local people as expressed in the interviews and discussions during the survey.

Dieback effect by age

An attempt was made to establish the relationship between dieback effect and the age of trees. The analysis revealed that the percentage of dead and dying trees of community, government, and private plantations increased after five years.

The dead and dying percentages of private, community and government plantations in the age class 1 to 5 was 2 percent (Table 2). With the increase in age class, the percentages of dead trees also increased (except for 21 to 25 age classes). In general, the higher percentages of dead and dying trees in community/government and private plantations were found in the two age classes viz. 11 to 15 and 16 to 20 years.

Types of plantation

About 90 percent of plantations were found to be monoculture, and 10 percent had more than one

tree species such as *Acacia catechu, Tectona grandis, Leucaena leucocephala, Eucalyptus* spp., *Melia azedarach, Azadirachta indica*, and some fodder species.

In the age classes 1 to 5, 6 to 10 and 16 to 20, the proportion of dead sissoo trees in polyculture were less than those found in monoculture (Table 4). Over all ages, the proportion of dead trees in polycultures was slightly lower than in monoculture. The proportion of dying trees in all the age classes except 1 to 5 years was less in polyculture than in monoculture. Mostly, mixed plantations have not been established in a systematic pattern. Table 4 indicate that the effect of dieback was less as expected, in mixed plantations than in monoculture. It could be said that its effect could be further lowered by planting other tree species in a systematic spacing in suitable sites.

bari for upland used mainly for maize. Besides these land types, sissoo are planted on homesteads and on the edges of ponds. Government or community plantations were mostly established in open land (grazing land or fallow land), forest land (degraded either due to encroaching or heavy exploitation.

Generally, it was found that less than 10 percent of trees were dead in all the age classes on all types of land used for planting sissoo (Table 4).

Sissoo dieback at Breeding seed orchards (BSOs) and adjoining plantations

A comparative study of sissoo dieback at BSOs and adjacent plantations revealed that sissoo at BSOs were comparatively more tolerant than in other plantations. Only 0.66percent of trees at BSOs were recorded dead. However, this figure in other plantations is 13.17percent (Table 5). One

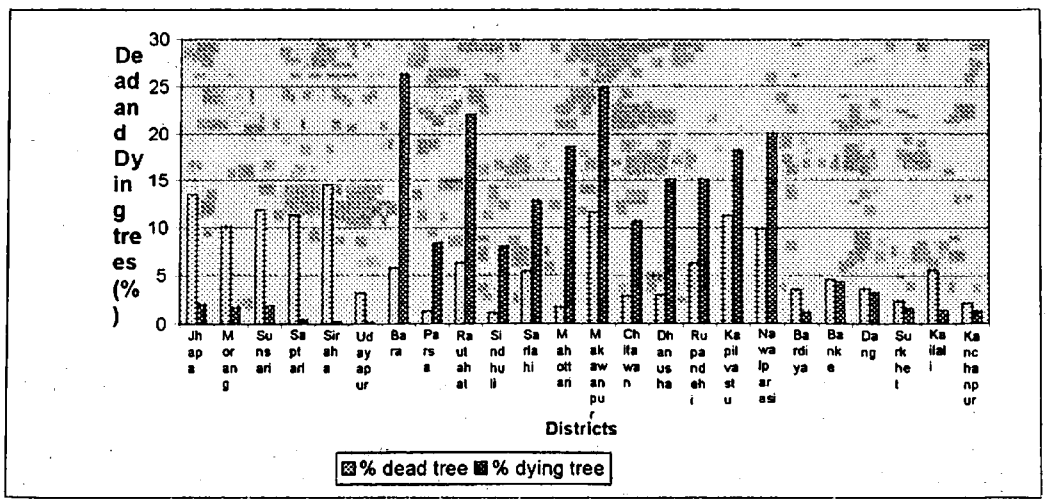

Figure: 2: Percentages of dead and dying trees in sissoo stands at 24 districts

Land type used for planting

It was found that sissoo was planted on a wide range of land types. The majority of private plantations were established on khet and bari land. Khet refers to land used for paddy cultivation and noticeable factor was differences in the age of plantation. In addition, intensive site preparation, and close spacing was practiced in BSOs as compared to general plantation. The average age of BSOs was four years and of general plantations eight years.

Table 2: Mean percentages of dead and dying trees by age classes

Age class (years)	Types of plantation			
	Commuity/government (% of dead trees)	Private (% of dead trees)	Community and government (% of dying trees)	Private (% of dying trees)
1-5	2.0	2.0	6.8	5.9
6-10	8.5	6.9	11.3	5.6
11-15	8.8	12.5	9.0	12.0
16-20	14.8	9.6	16.2	14.2
21-25	7.5	24.6	18.5	4.1

Table 3: Stocking, dead and dying trees per ha, dead and dying percents of community, government, and private plantations by types of plantation (monoculture polyculture)

Age class (years)	Monoculture				Polyculture			
	Dead trees per ha	Dying trees per ha	% dead trees	% dying trees	Dead trees per ha	Dying trees per ha	% dead trees	% dying trees
1 to 5	23	45	2.4	5.2	8	105	0.8	11.5
6 to 10	56	65	7.2	8.3	31	59	5.3	6.6
11 to 15	56	64	9.1	9.5	67	59	10.1	7.1
16 to 20	63	64	15.9	17.5	53	35	13.2	7.7
All ages	50	60	7.8	8.9	47	60	6.7	8.3

Effect of silvicultural management

The study showed that silvicultural management had a positive impact against sissoo dieback. Table 6 shows a comparision of dead trees in managed and unmanaged sites as 7.96 percent and 13.94 percent respectively. However, the percentage of dying trees in both sites was nearly equal.

cuttings. Mixed genetic materials used for plantation had 8.47 percent and 10.04 percent respectively.

Effect of seed source

It was very difficult to trace the seed sources of sissoo plantations. People were not found to be

Table 4: Average stocking, dead and dying trees per ha, dead and dying percents of community, government, and private plantations by types of land

Age class (yrs)	Types of land							
	Bari				Khet			
	Dead trees per ha	Dying trees Per ha	% dead trees	% dying trees	Dead trees per ha	Dying trees per ha	% dead trees	% dying trees
1 to 5	5	86	0.5	8	40	33	3.9	4.8.
6 to 10	53	101	4.9	8.4	77	66	6.4	4.4
11 to 15	99	144	10.3	14.1	90	60	10.4	5.8
16 to 20	-	-	-	-	86	55	18.6	15.5
21 to 25	-	-	-	-	33	58	6.1	11.3
All ages	52	106	5.3	9.6	72	56	8	6.2

Age class (yrs)	Forest land				Open land				Stream bank			
	Dead trees per ha	Dying trees Per ha	% dead trees	% dying trees	Dead trees per ha	Dying trees per ha	% dead trees	% dying trees	Dead trees per ha	Dying trees ha	% dead trees	% Dying trees
1 to 5	36	29	4.2	3.3	15	70	1.4	7.6	-	-	-	-
6 to 10	36	57	8.9	13.1	45	25	7	3.4	-	-	-	-
11 to 15	47	33	9.5	8.2	44	50	9.2	11.4	7	23	3	7.7
16 to 20	31	74	7.4	18.8	123	6	36.8	1	9	11	2.4	2.9
21 to 25	15	36	8.3	19.9	25	72	8.4	38.5	-	-	-	-
All ages	37	45	8.6	12.2	44	42	9	8.3	7	21	2.9	6.9

Effect of sissoo genetic materials

Three types of genetic materials - cuttings, seedlings and mixed (both cuttings and seedlings in the same plantation area) were found to be used for sissoo plantations. Plantations established from seedlings had a low percentages (3.39) of dead trees (Table 7). Out of 3357 trees surveyed in 54 ha plantation area, 14.12 percent trees were dead and 20.29 percent were dying in sissoo plantations established from

aware of the importance of seed sources. Sagarnath and Nepalgunj Forest Development Projects have little records on seed sources where as government plantations established by the District Forest Offices have no record at all. For the present study, seed source has been broadly categoried into those collected from Plus trees, Local stands and Unknown.

The study showed that seed sources from plus trees was less affected by sissoo dieback compared to

Table 5: Sissoo die-back in BSOs and three adjoining plantation sites

District	BSOs					Three Adjoining Sites				
	Age (yr)	Area (ha)	Total Trees	Dead	Dying	Age (yr)	Area (ha)	Total Trees	Dead	Dying
Banke	2	1.17	4883	0.06%	3.60%	7.3	10	875	8.11%	11.09%
Kapilbastu	4.5	1.34	4550	0.53%	25.93%	10.6	15	1234	23.91%	21.55%
Chitwan	6	2.3	3360	1.73%	7.53%	6.3	6.5	982	4.18%	3.36%
Total	12.5		12793	85	1609	24.2	31.5	3091	407	396
% / Aveage	4.17			0.66	12.58	8.07			13.17	12.81

seed from local or unknown stands (Table 8). During the selection of plus trees, a 10 percent weightage was given to the disease free characteristic of tree.

Effect of dieback on plus trees

Out of 84 sissoo families, twenty families were commonly planted at all BSO sites. Efforts were made to survey all plus trees of commonly planted sissoo trees, but only ten plus trees were identified and surveyed. The study showed that all surveyed plus trees were normal and healthy and dieback was not observed. However, a survey of five trees neighbouring each plus tree showed that ten out of fifty trees were dead. This means dieback was present in natural conditions, but with less in healthy and vigorous trees. This justifies the importance of giving a 10percent weightage to disease free character during the selection of plus trees.

Offspring of these ten plus trees did not show consistent performance at different BSO sites. The overall performance of these families in BSO sites is also similar to the total average of all plus trees.

Ento-pathological findings

Ranking of insect damage

Based on the observations and analysis of samples collected the results can be categorised in two entomological aspects of ranking of insect damage and infested plantation. Ranking of insect damage showed that Pinhole damage was most frequently occured and Saw dust and Heartwood borer damage was less (Table 9). Similarly, ranking of infested plantation showed that enriched site was mostly infested followed by agriculture (Khet land) and River side (Table 10).

Table 6: Effect of silviculture management on sissoo dieback

Silviculture management	Plot	Average Age (Yr.)	Area (ha)	Total Trees	Dead	Dying		
						Top Dying	Infected	Total
Not applied	10	8	42	3351	13.94%	14.03%	2.95%	16.98%
Applied	6	13	43	2273	13.94%	11.39%	5.63%	17.03%

Pathological symptoms

The external common symptoms exhibited by the affected trees include several branches defoliated from the top, gum seepage in many cases, sloughing off bark and discoloration of the stem in advanced stages. In certain plantations gum seepage was severe, appearing on the lower portion of the stem. But the leaves of almost all trees were normal during the survey period. Very few leaves on certain trees were showing leaf blight symptoms with a yellow margin.

Table 7: Effect of genetic materials used on sissoo dieback

S. No.	Genetic Materials Used	Plot	Age(yr)	Area(ha)	Total Trees	Dead	Dying
1	Cuttings	10	9	54	3357	14.12%	20.29%
2	Seedlings	2	12	3	354	3.39%	23.45%
3	Mixed	4	10	28	1913	8.47%	10.04%

Fungi belonging to 17 genera (*Fusarium oxysporum, F. solani, F, lateritium, F.* spp. *Phytophythora* sp, *Phoma* sp, *Rhizoctonia* sp, *Cylindrocladium* sp, *Myrotheciumsp,Diploids* sp., *Menispora* spp. *Macrophoma* sp, *Botryodiplodia* sp, *Graphium* sp, *Gloesporium* sp, *Alternaria* sp, *Diaporthe* sp, *Cladosporium* sp, *Aspergillus* sp, *and Collectotrichum* sp) were identified from different parts of the trees (Appendix 2 and 3) 11 on root samples, 6 on stem, 7 on bark, 8 on leaf, twig, petiole and 3 on frass). The average mortality percent of trees, excluding stumps was observed to be 9 percent from a total of 431 trees in the sample area. Among them, *Fusarium* species was observed to be the most common, and the species *solani* was recorded in many of the samples of sissoo plantation. Root rot due to *Phytophthora* sp. was also observed in one location only. Vascular wilt in sissoo trees might have been caused by *Fusarium* species complex.

Soil survey analysis

Most of the disease or dieback in sissoo trees was observed at unfavourable sites such as khet land. The majority of khet lands has dry and compact soil during the dry season and waterlogged during the rainy season. Such types of land are unfavourable for growth of sissoo. But the dieback was less in riverside plantations in comparison to other sites.

The roots of plantation sissoo did not resemble with those growing in natural sites. In plantation plots, the peripheral and tap roots were not well developed, where as, in natural condition, they have long peripheral and tap roots. The change in the root structure might have effected the water absorption capacity of the tree and its life span which may have been reduced by 15 to 20 years due to insufficient absorption of the water from the

Table 8: Effect of sissoo die-back on seed sources used

S.No.	District	Plot	Age (yr)	Area (ha)	Total trees	Dead	Dying
1	Plus Trees	3	2	4	12793	0.66%	12.58%
2	Local stands	8	12	60	3350	15.43%	18.69%
3	Others	8	8	25	2274	5.76%	14.51%

Table 9: Ranking of insect damages and plantation locations

Districts	Total sites	Pin hole damage	Zigzag damage	Red sap damage	Termite damage	Heartwood borer damage	White pupae / lavre kira damage	Red ant damage	Saw dust damage	Total	Rank
Morang, Sunsari, Jhapa	16	11	2	7	3	1	0	0	0	24	2.
Chitwan, Mahotari	26	9	5	8	14	1	5	7	2	51	1
Nawalparasi	10	3	0	3	4	0	2	1	1	14	4
Kanchanpur	10	4	0	4	5	1	0	1	0	15	3
TOTAL	62	27	7	22	26	3	7	9	3	104	
	Rank	1	5	3	2	6	5	4	6		

Table 10: Ranking of insect damages as to different types of plantation sites.

Insect damages	Plantation types								
	Agriculture sites	Road sites	River sites	Enriched sites	Natural sites	Canal sites	Bariland sites	Total	Ranking
Pin holes	5	3	3	6	3	4	3	27	1
Red sap	5	3	3	6	2	3	0	22	3
Termites	3	4	8	5	2	2	2	26	2
Heartwood borer	2	0	0	1	0	0	0	3	6
White pupae/larvekira	1	2	2	0	0	2	0	7	5
Red ants damages	0	2	3	2	2	0	0	9	4
Zigzag damages	2	1	0	2	0	2	0	7	5
Saw dust	1	0	0	1	0	1	0	3	6
TOTAL	19	15	19	23	9	14	5	104	
RANKING	2	3	2	1	5	4	6		

soil. This could be one silent reason for the sissoo die back disease.

Recommendations

Based on the present study, the following recommendations have been made;

Preventive measures

- The monoculture should be discouraged
- Plantations should be established only from known and quality seeds, such as from BSOs.
- Seeds from resistant strains of the plants should be used as germ plasm for plantation.
- The site-species matching should be assessed before species selection for plantation and species-site suitability should be given a high priority
- Regular silvicultural operations or plantation hygiene should be maintained. This includes climber cutting, weeding, removal of debris and dead, diseased and dying trees and so on. In this way, the disease resistance of the plantation can be enhanced. Operation of the scheduled singling, pruning and thinning should be practised as per the advice of the silviculturist.
- Multipurpose forest management should be encouraged. The forest enterprise should be planned for multiple products. This will not only reduce the risk of loss and uncertainty of plantation but also result in optimal utilisation of per unit area.
- Although, plantations from seedlings were found less affected than from stumps, it needs further confirmation

Curative measures

- Dead and dying trees must be removed and burnt to prevent further multiplication and spread of the pathogens.
- Timely use of systemic insecticides in the roots of infested trees @ 5 ml/ 5 lt water @ five to ten litres of this solution per tree at intervals of fifteen days is recommended for control of the borer insects.
- Bordeaux paste (50 percent lime + 50 percent Copper sulphate + water) can be painted on the base of the stem upto 3 feet for prevention of termites. Termiticides can be applied at the roots of infested trees.

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Appendix 1: Stocking, survival percent, dead and dying trees per ha, percentages of dead and dying trees in all sissoo stands (natural and plantations) at 24 Districts.

District	No. of sissoo trees/ha	S (%)	No. of dead trees/ha	No. of dying trees/ha	% of dead tree	% of dying tree
Jhapa	647	31.3	54	11	13.5	2.0
Morang	704	36.9	77	13	10.1	1.7
Sunsari	654	27.8	87	14	11.9	1.9
Saptari	811	34.2	70	4	11.3	0.5
Siraha	774	34.8	109	2	14.6	0.3
Udayapur	994	38.3	32	2	3.2	0.2
Bara	534	29.0	78	125	5.8	26.4
Parsa	850	46.8	12	72	1.4	8.5
Rautahat	632	45.6	68	168	6.4	22.2
Sindhuli	604	30.7	9	61	1.2	8.1
Sarlahi	489	28.5	27	63	5.5	12.9
Mahottari	648	38.7	11	121	1.7	18.7
Makawanpur	1293	50.9	150	323	11.6	25.0
Chitawan	817	33.2	24	87	2.9	10.7
Dhanusha	624	39.7	19	96	3	15.2
Rupandehi	591	25.8	44	83	6.3	15.2
Kapilvastu	427	20.7	45	78	11.2	18.3
Nawalparasi	445	24.7	46	112	9.9	20.1
Bardiya	788	43.2	28	13	3.5	1.2
Banke	1272	32.9	61	58	4.6	4.3
Dang	1098	59.2	40	36	3.6	3.2
Surkhet	1258	51.2	29	20	2.3	1.6
Kailali	753	45	30	10	5.6	1.4
Kanchanpur	904	47.5	19	12	2.1	1.3
Mean	775	37.4	49	66	6.4	9.2

Appendix 2: Results of laboratory analysis of fungi associated/isolated from root samples

S. No.	Plantation site	*Fusarium oxysporum*	*Fusarium solani*	*Phoma* sp.	*Macrophoma* sp.	*Rhizoctonia* sp.	Others
1.	Bari, Bastipur, 1	+ 19 %	+ 39 %	+37 %	+ 5 %	-	
2.	Enrichment Tama., 2	-	+ 85 %	-	-	-	
3.	Agri-khet Narasingha, 5	-	+ 100 %, + (p)	-	-	-	
4.	Enrichment TIP + Dharan fa. bari, 7		+	-	-	-	*Fusarium* sp
5.	Agri-khet Daulatpur, 9	-	+ 16 %	-	-	-	
6.	Natural Surunga, 10	-	+ 70 % + (p) 30 %	-	-	-	*Fusarium* sp
7.	Riverside, Kerkha, 11	-	+ 100 %	+ 60 %	+	-	-
8.	Canalside Baklauri, 15	-	+ 30 %	-	-	+	
9.	Agri-khet Bhokara, 25	-	+ 40 %	-	-	-	*Fusarium* sp, *Phytophthora* sp.
10	Riverside at Sunsarikhola, 16	-	+ 10 %	-	-	-	*Cylindrocladium* sp
11	Riverside at Narayani	-	+ 90 %	-	-	-	*Fusarium* sp.
12	Canalside Shivanagar, 17	-	+ 100 %	-	-	-	
13	Agri-bari, Ramghat, 18	-	+ 90 %	-	-	-	
14	Riverside at Ratnanagar	-	+ 100 %	-	-	-	
15	EnrichmentUrl abari,12	-	-	-	-	+	*Fusarium* sp. *Aspergillus sp.* *Phyllosticta sp.*
16	Roadside, Makar, 22	-	+ 80 %	-	-	-	*Myrothecium* sp
17	Canal side Bhandara	-	-	-	-	-	*Fusarium* sp.
18	Riverside Nagarban 20						*Botryodiplodia* sp. *Cladosporium*, sp.

Appendix 3: Results of laboratory analysis of fungi associated/isolated from stem, leaf, twig, petiole, bark samples and one on frass

Plant parts	Plantation site	*Fusarium oxysporum*	*Fusarium solani*	*Phoma* sp.	*Macro-phoma* sp.	*Rhizoctonia* sp.	Others
Stem	Agribari Bastipur, 1	+	-	-	-	-	
Leaf	do	-	-	-	-	-	*Phomopsis* sp.
Leaf (Black tip rolled)							*Colletotrichum* sp.
							Fusarium lateritium
Petiole	do	-	-	+	-	-	
Stem	Enrich,	-	-	-	-	+	*Fusarium* sp.
	Tama, 2	-	+, (p)	-	+	-	*Fusarium lateritium*
Stem	Canal Shankerpur	-	+, (p)	-	-	-	*Botryodiplodia* sp.
Stem	Enr. TIP, 7	-	+	-	-	-	
Stem	Riverside Chisang, 13	-	-	-	-	-	*Fusarium* sp
Stem	Canal Shivanagar	-	-	-	-	-	*Botryodiplodia* sp
on frass			+				Synnemata of *Graphium* sp., Cladosporium sp.
Bark	Natural, Surunga 10	-	+	-	-	-	
Bark	Riverside Kerkha, 11	-	+	+	-	-	*Alternaria sp.*
							Cladosporium sp.
Leaf	Roadside Laxhmipur, 14	-	-	+	-	-	*Diaporthe* sp.
							Phomopsis sp.
Bark	Canalside, Baklauti, 15	-	-	-	-	-	*Botryodiplodia* sp.
							Graphium sp. and
Bark	Agri-khet, Bhokara 25	-	+	-	-	-	*Fusarium* sp
							Botryodiplodia sp
Bark	Riverside Ratnanagar 18	-	-	+	-	-	
Leaf	Narayangadh Canalside	-	-	+	-	-	*Phomopsis* sp
Petiole	Bhandara 21	-	-	-	+	-	*Gloeosporium* sp.

+ (p) indicates the perithecial stage of *Fusarium solani* (*Nectria haematococca*)