DALBERGIA SISSOO DIE BACK-PROBABLE SUSPECTS

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Abstract

Study was initiated during 2004 at the Peshawar University Campus. Reconnaissance of the campus road side Shisham plantation was conducted. Data of 5 randomly selected trees of road side plantations, each of 1 km indicated that only 16% of the 535 trees were healthy, 20% top die, 30% vertically half dead, 20% thinned canopy and 14% completely dead. There were observed the presence of termite on 49%, black or red blood like exudation on 32%, insect borer or bore holes on 29%, canker on 26%, white threads or black fungal material (especially on butt portion) on 13% of the total avenue trees of 5 km.

The number of dry patches, beneath the bark in the sapwood were maximum (5) in thinned canopy followed by top die (3) and vertically half dead (1). The continuity of such patches towards crown and root was confirmed by making the cross sections of stem logs and excavating root system of top die tree. Besides, there were recorded 9 dead roots in top die, 7 in thinned canopy, 6 in vertically half dead and none in healthy. A maximum number of termite royal chambers with fungal garden were noted in thinned canopy followed by completely dead, top die and healthy tree. White or black fungal material and decay of roots were recorded on all the tree roots except completely dead. However no Rahizobial nodules were noted on any of the tree root system. All cross sections depicted the presence of white powdery streak at center or at periphery of damaged central part. Small out growths directed from heart wood into sapwood were noted in first 3 cross sections of first 3 consecutive logs.

Presence of i) white or black fungal material both on stem and root ii) exudation either of black or red blood colour iii) dry patches in stem/root and drying of roots and iv) white powdery streak in cross sections are leading to the conclusion that there have been the possibility of some fungal attack resulting in blockage of conducting tissues, causing heart wood rot followed by termite attack and elimination of Rahizobial nodulation. Therefore, it is suggested to carry out an intensive field survey; study the biology, physiology and ecology of the suspected fungi and Rhizobial nodulation pattern.

Introduction

Dalbergia sissoo, growing naturally in sub Himalayan tract extends over a vast region throughout Indo-gangetic plain. It prefers well drained sandy loam

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soils with good moisture supply. Primarily Sissoo being hygro-phyllous in nature grows very well throughout the irrigated conditions. However growth is slow in badly drained heavy clay soils, rocky outcrops and moderately or highly saline soils. It is frost and drought hardy species. The tree coppices well and produce a large numbers of root suckers under normal growth conditions. (Brandis, 1921). The normal Shisham tree shows leave fall during November-December and new leaves appears in January-February. While the flowers make their appearance along with the new leaves and reaches to bloom during March-April. The pods attain full size (5 to 8 cm long) by July but ripen in December-January (Troup, 1921).

Shisham die back is being the burning issue of the country has already been a focus of attention of the Mycologist who have recorded more than 62 species of fungi on Shisham. No records of the Bacteria or Virus have been made (Khan, 1989). Some of the most important diseases recorded so far include powdery mildew, leaf spots/leaf mould, leaf blight, leaf rust, wilt, collar rot, die-back, canker, root rot, wood rot, trunk rot, Mistletoe attack, etc (Khan, 1989; Bajwa, 2003; Harsh et.al., 2003; Naz, 2002; Khan, and Khan, 2000).

Academically the die-back is described to cause the reduction in growth, shortening of internodes, root necrosis, premature fall coloring, sprouting from adventitious buds, increased prevalence and pathogenecity of root decay fungi, nematodes, insects etc. (William and Edwin, 1994). The disease has been found attacking not only Shisham but also other tree species like kikar, simal, mango, citrus, etc growing on farmlands, road side and canal side plantations (Annon, 2001).The most apparent practical sings of die back noted in plantations include top die condition, thinning of the canopy, vertically half deadness of tree, pale green leaves/flowers/pods, wilting, presence of canker and black/brown exudation, termite attack, insect bore holes, etc (Shukla, 2002 and Manandhar & Shrestha, 2000).

The Shisham, dominating tree species of the campus varies in age from young to very old. But unfortunately this dominating tree is being affected by the dilemma of die-back syndrome in the whole campus. Tree disease pattern is very interesting, some are drying just at the top giving the appearance of stag headedness, some showing vertical division of the tree into dry and lush green parts, some show the severe thinning of the crown, some standing with yellow/ golden or tan coloured or light green leaves and many completely dead and dried. The present study is designed to determine suspects of die-back by undertaking detailed examination of aerial as well as under ground parts of the tree.

Material and Methods

Peshawar University campus, encompasses an area of 425 ha has a great diversity of tree culture. The road side plantation of the campus was selected and a reconnaissance was undertaken to categorize the Shisham trees into different groups, based on their morphological appearance. Thus recorded groups include top die, vertically half dead, severely affected tree, completely dead tree and healthy tree. Out of the whole road side plantation of the campus only 5 different sections each of 1 km on the average were enumerated to record data on age and DBH , presence of insects/pathogen, exudation, canker, canopy condition, etc. Detailed examination of the disease causing suspects either on the aerial parts or on the root systems of the Shisham was carried out by selecting a representative tree /group at the following locations in the university campus.

(i)	Top die	PFI campus
(ii)	Vertically half dead	Peshawar University Campus
(iii)	Severely affected tree	PFI camps
(iv)	Completely dead tree	Peshawar University Campus
(v)	Healthy tree	PFI campus

An area of 4 meter diameter and 60 cm deep around the each representative tree was excavated very carefully. The extraction work was carried out with the help of sickle, khurpa, chisel, bailcha, kudal, hand saw, knife, prunner, axe, taggary, jabal, ganity, hammer, caliper, increment borer, hand lens, etc.

Data with regard to the presence of insect pests, fungal structures, patterns of root drying, root knots, root exudation, root sprouting, root nodules, etc were recorded. The main stem of all these five marked trees was debarked at the breast height by making a ring of 2.5 cm deep and 15.0 cm wide to record the symmetry of dry patches in the standing stem.

The top die tree was felled with the help of chain saw and cut into different logs. 7 cross sections each of 15 cm thickness were taken at each basal end of the log to study the changes in sapwood and heartwood. Data on the width of sapwood & heartwood, number of dry patches, presence of insect pest and pathogen damage, etc were recorded for each section.

Results and Discussion

Survey results showed that there have been growing 535 Shisham trees mixed with other tree species on both sides of selected 5 km road of university campus. Only 16% of the total trees were healthy while, rest 84% were appeared as diseased. The breakup of these diseased trees was 20% top die, 30% vertically half dead, 20% severely attacked and 14% completely dead. The average DBH of 41 cm, 50 cm, 49 cm, 54 cm, and 39 cm was recorded in healthy, top die, vertically half dead, thinned canopy and completely dead trees respectively. The results of the disease causing suspects showed the presence of termite on 49%, black or blood like red exudation on 32%, insect borer or bore holes on 29%, canker or injury (southern aspects) on 26% and whitish or black fungal material on 13% of total number of trees.

Detailed study of the suspects of the disease on the aerial parts of representative tree indicated that age and DBH varied from 18-38 years and 25-61 cm respectively. Exudation either of black or blood red colour was recorded on the main stem at 1 point on healthy, 3 points on top die, 5 points on vertically half dead, more than 10 points on thinned canopy and no exudation was recorded on completely dead. Shukla (2003) has also reported presence of stem canker and ozing of black pitch. Heavy termite attack was recorded on main stem of completely dead followed by top die (up to 150 cm) and mild attack at butt portion of vertically half dead and thin canopy trees. However, no termite and borer attack was recorded on healthy and top dying trees. Severe borer infestation was found on the main stem of thin canopy and completely dead trees. The fungal structures either of white threads or black powdery material were noted on all trees except fully dead.

At breast height in debarked ring a maximum number of dry patches (5) separated by varying width of alive sapwood were recorded in thinned canopy tree followed by top die (3) and vertically half dead (1). These dry patches were appearing to continue up towards the crown and down to the roots. Contrarily only one dry patch of 120 cm long tapering towards ends with 20 cm width at the center was recorded at the breast height of the healthy stem .The over all canopy condition was dark green with few dry branches (southern aspect) in healthy, green in top die, light green with half dead in vertically half dead, light green with a few young leaves and branches in thinned canopy and no leaves and young branches were recorded on dead trees. Such changes in the colour of canopy and presence of dry patches in sapwood indicated the blocking of conducting tissues of tree which could be due to fungal activities or deposition of some chemicals (Sharma et al, 2000 and Bakshi and Sigh,1959).

Root characteristics of same representative trees (table-1) indicated presence of fungal structures either as white threads or black powder along with decay (Plate-1) on all the trees except completely dead tree. Similar findings have also been reported by Harsh et al. (2003).

Plate 1 Root showing black coloured fungal material

A large number of narrow or wide royal chambers with fungal gardens were recorded in the excavated root zone of thinned canopy followed by completely dead, top die and healthy trees. Mild termite attack and a white coloured bark borer were recorded on vertically half dead tree. A large number of root knots were noted on fibrous roots of top die followed by vertically half dead, thinned canopy, none on healthy and fully dead tree. Surprisingly none of the representative tree showed the presence of Rhizobial nodulation on their roots which is the basic characteristic of leguminous trees (Chopra, 1984). Besides, a maximum number of 9 dead roots were recorded in top die followed by 7 in thinned canopy and 6 in vertically half dead (plate-2) and none in healthy. The number of dead roots and their diameter details are shown in table-1.

Plate 2 Dry patch in stem continues to root

The root-drying appeared as the continuity of the same drying patches in the stem (plate-2). These drying roots were either completely dead or partially dead. Drying pattern of roots was from stem to root and root to soil in all trees except one root in case of top die where drying was from root towards stem. Majority of live roots sprouted with in 15-20 days after excavation in top die (Plate-3), vertically dead and thinned canopy trees.

Table 1: Root characteristics of the representative tree of five categories of shisham growing at university campus

Tree group	Fungal structure	Insects		Root knots	Dia. of main live roots cm	Number of dead root & dia (cm)	Pattern of drying	Number of roots sprouted after 15-20 days
		Termite	Borer					
Healthy	White threads and black powder	Many small royal palaces with fungal gardens	Nil	Nil	6-25	Nil	Nil	Nil
Top die	Black powder	Heavy infestation but no Royal palace	Nil	Many on fibrous roots	3-19	9 (11-15)	Complete dead in continuation to dead parts in the stem, Partially dead , drying from stem to soil and soil to stem	All live
Vertically half dead	White thread and black powder	Mild attack	White colour bark borer	Few on fibrous roots	4-19	6 (8-14)	1, on the same drying side of the stem, 5 dead black ended	10
Thinned Canopy	White threads and black powder	Many Royal palaces with Fungal gardens	Nil	Few on fibrous roots	8-30	7(5-17)	Complete dead in continuation to dead parts in the stem, partially dead , drying stem to soil	All live
Dead full	Internal decay	Heavy infestation but no R. palace	Nil	Nil	N.A.	N.A.	N.A.	Nil

Data with regard to different characteristics of cross sections of the top die tree showed that diameter of cross sections varied from 19-54 cm and thickness of sapwood and heartwood varied from 1.5-2.0 cm and 7.0-24.0 cm respectively. Maximum number (5) of dead patches were recorded in cross section 1 (basal section) followed by 2 in cross sections 3,4 & 5; 1 in cross section 2 and non in others (Plate-3).

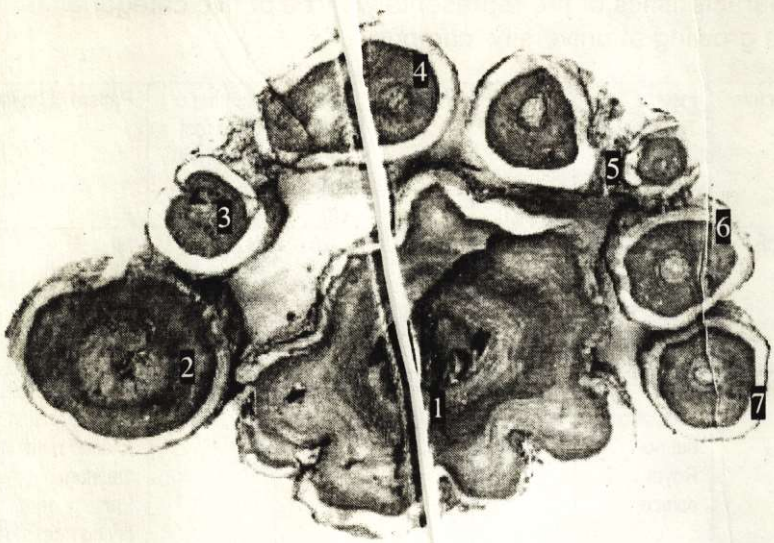

Plate 3: Cross sections of stem with dead patches, decay pockets and white powdery fungal material

All cross sections showed presence of white powdery streak (lines and pockets) at center of cross sections or at periphery of damaged central parts of cross sections (Plate-3) .This could be due to white rot causing fungi attacking heard wood tree species .There have been observed an abnormality of presence of small out growths from heart wood towards sapwood as shown in section 1, 2, and 4 of Plate-3. These outgrowths may result into plugging of conducting vessels and formation of drying patches in stem and ultimately leading to the drying of trees and same has also been documented by Annon (2004). Complete damage of the central heartwood caused by termite was recorded in sections 1 & 2, partial damage in cross section 3 and non in the remaining. Besides 6 borer holes were also noted in the sapwood and heartwood of section 1. This insect damage could be secondary in nature and followed by the fungal wood decaying activities

Conclusion

Presence of dry patches in sapwood of stem and their continuation in roots confirmed by study of cross sections of stem indicated that some sort of agencies blocking movement of sap from soil towards crown. Additionally, presence of white streak at center of cross sections could be due to attack of white rot causing fungi. And same part of the wood might later on be attacked by termite.

On the other hand presence of white threads or black powdery material on roots and on surface of stem again supports the idea of fungal attack both on stem and root.

Based on these findings it will be appropriate to carry out:

1) A detailed field survey both in man made and natural plantations with the objectives to testify above findings in different locations.

2) Detailed study of the Biology, Physiology and Ecology of these suspected fungi and termites.

3) Investigations on factors responsible for absence of Rhizobial nodulation.

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