

AN OVERVIEW OF SHISHAM MORTALITY



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- Shisham is native to the plains, low hills and mountain valleys of the sub-Himalayan region.
- Occurs naturally from the Kabul River in Afghanistan through northern Pakistan, northern India, Nepal, Bhutan and Bangla Desh.
- Commonly grown throughout most of Pakistan, north India and the Terai region of Nepal.
- Successfully introduced to other parts of the Asian subcontinent as well as Southeast Asia, Africa, the Middle East, the Caribbean, tropical America, and Florida and Arizona in the United States.
- Occurs commonly from sea level up to 1000 m sometimes even up to 1500 m.

- Riverine environments where sunlight and moisture are plentiful with annual rainfall averaging 500 to 4500 mm in the native range.
- Temperature in native range varies from 4° to 50°C.
- Tolerant of light frosts but killed by low temperatures or long freezes.
- Grows well on rich alluvial soil, pure sand or gravel conditions with plentiful moisture and good drainage.
- Survive the periodic flooding associated with riverine sites but show poor growth under waterlogged conditions.
- Require a pH of 5.0 to 7.7 and tolerate some salinity, but growth is stunted on heavy clay soils.
- Natural regeneration is also common on newly exposed sites such as embankments, freshly repositied alluvials, landslides, and abandoned farmland i.e. young soils, but not suitable for mature soils.

Shisham Mortality: Causes, Symptoms and Factors

- ❖ Shisham mortality spread throughout the Shisham distribution zone, more severe in eastern Uttar Pradesh and Bihar
- ❖ Two pathogens responsible for shisham mortality
 - ❖ *Fusarium solani* f. sp. *dalbergiae* causing vascular wilt
 - ❖ *Ganoderma lucidum* causing root rot
- ❖ Symptoms – Yellowing of foliage, followed by gradual wilting and drying leading to top dying, oozing of sap (pitch) and ultimately complete death of the plant

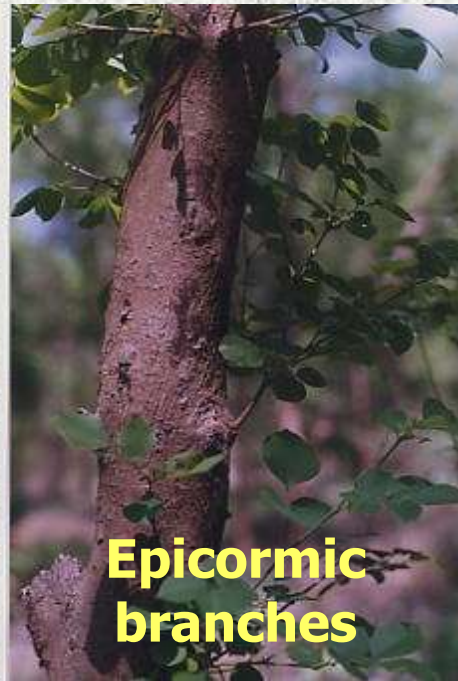
- Decline/ wilt are result of both root rotting and colonization of vascular system of stem by the fungus, which blocked water transport through fungal structures and fungal metabolites and byproducts.
- Pathogen moves up the stem from the roots, *F. solani* found in soil, roots and stem as established through DNA finger printing
- Fungus can tolerate wide pH range from 4.0 to 10.0 and temperature range from 10 to 35°C, optimum being 20 – 25°C
- Virulent and avirulent strains of *Fusarium solani* f. sp. *dalbergiae* exist
- Resistant and susceptible seed sources and clones against *F. solani* and *G. lucidum* have been identified

- Mixed plantations show less mortality
- Trees of all the age and diameter classes are affected in the monoculture plantations
- Mature trees of more than 50 years age are the most affected in plantations
- Younger plantations of Shisham show high mortality in some areas, particularly where biotic stresses, and erratic rainfall and extreme temperature variations/water-logging have occurred during recent years.
- Dead trees, partially dead trees as well as stumps are not removed acting as source of infection
- Invasive species like *Prosopis* and *Capparis* offer competition to shisham.

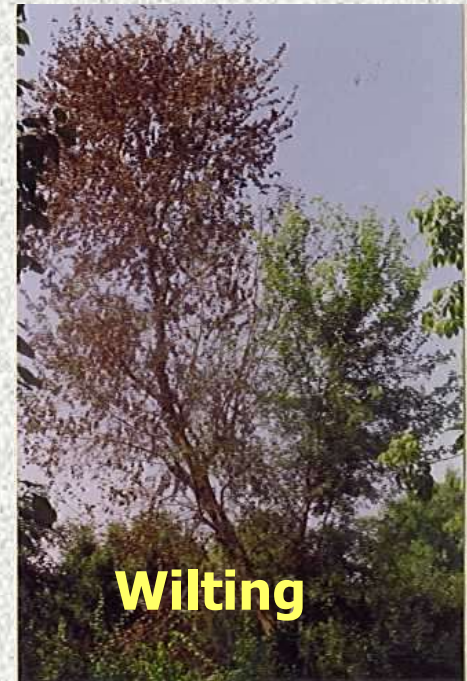
**DISEASE
SYMPTOMS
OF
SHISHAM
WILT**



Yellowing



**Epicormic
branches**



Wilting



Dying of trees



Oozing

SYMPTOMS.....



**Young shisham
plantation**



Oozing of pitch



**Wounds under
the bark**

SYMPTOMS.....



Black pitch oozing from vessels



Initial girdling



Swelling above girdling



Advanced girdling

Pathogen



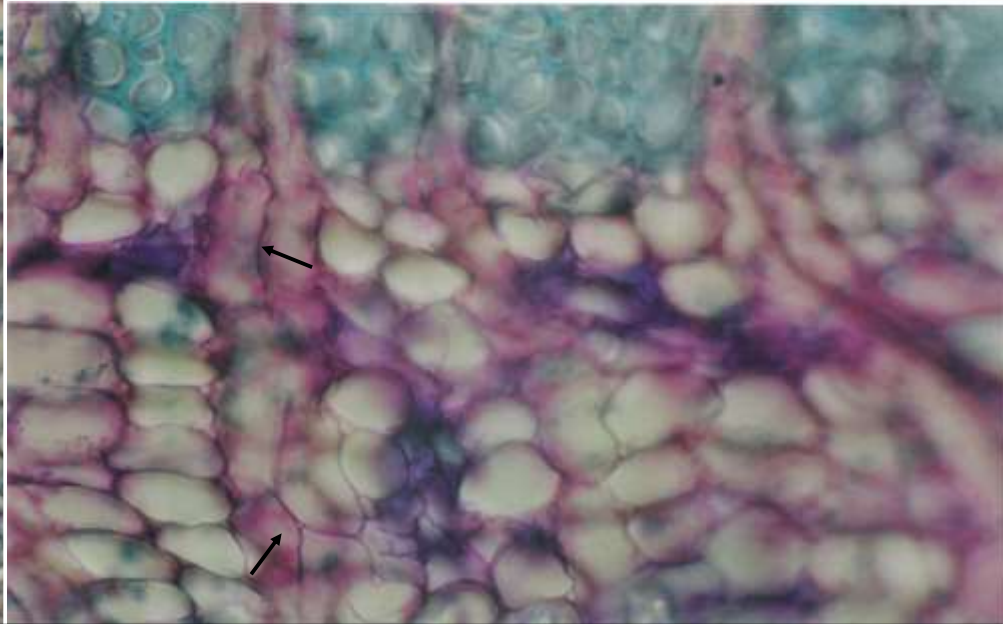
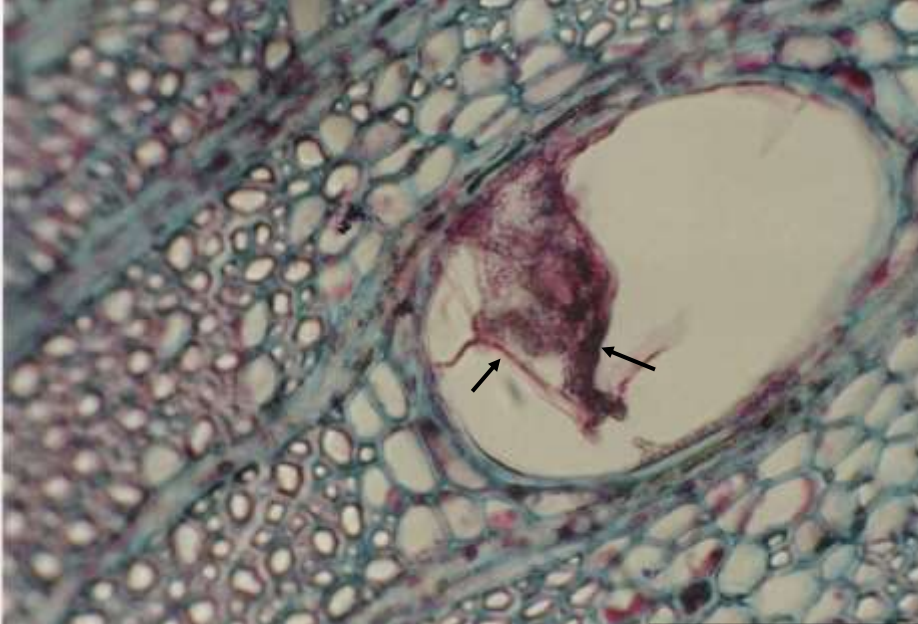
Culture of *Fusarium solani*



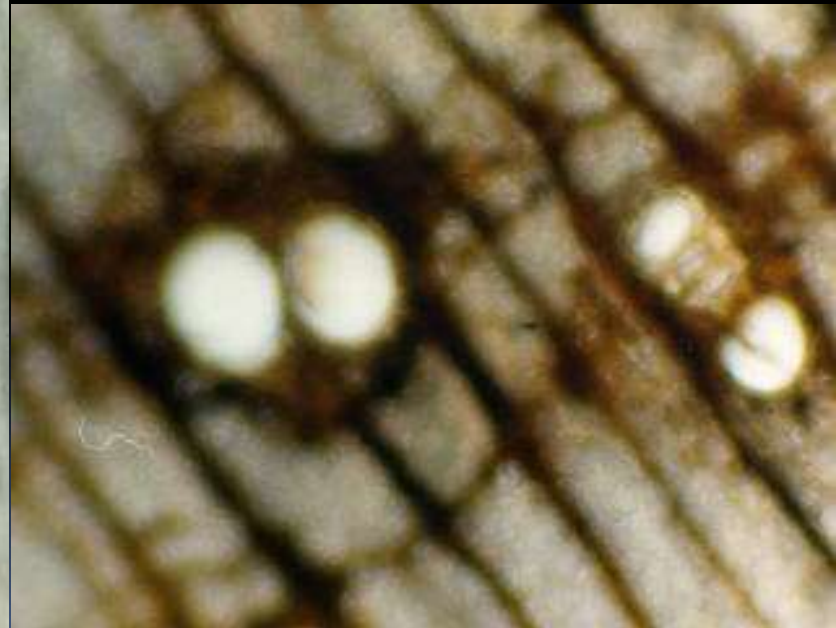
Phialides



Micro- & macro-conidia



Fungal structures in xylem vessels, intracellular spaces and obstruction by secondary metabolites





Wilt and mortality caused by *Ganoderma lucidum*



Wilt and mortality caused by *Ganoderma lucidum*



Ganoderma lucidum



Ganoderma lucidum



**Harrowing done by tractor
at Bhitmera, Hissar –
caused damage to root
system and spread
infection by *G. lucidum* –
providing an ideal sick plot
for the study**



Predisposing factors for shisham mortality – edaphic, ecological and biotic

- **Unsuitable site selection – shisham grows well on well-drained sites and does not grow well in soils of heavy texture (with more clay and silt content and less sand)**
- **Improper soil aeration in stiff and clayey soils causing death of fine/feeder roots due to asphyxiation**
- **Water logging, even for a short duration, causes poor aeration and death of fine/feeder roots due to asphyxiation**
- **Root disease pathogens enter through these dead roots (infection courts) and then attack living roots**
- **Extended period of low temperature and freezes**

Biotic pressure resulting into weakening of tree vigour such as:

- Injury to roots in agriculture (in fields) and construction activities (near roads, avenues)
- Cleaning and weeding done through harrowing in plantations causing root damage
- Covering of basal area with landfill, garbage and other material particularly on roadsides and urban areas
- Uncontrolled lopping in agriculture fields
- Blazing of bark for numbering of trees (on roadsides)
- Injuries by cattle
- Intentional girdling (on roadsides/ residential areas for removal)

All these biotic pressure result into opening of wounds, site deterioration and overall weakening of vigour resulting into attack by the pathogens and decline/mortality.

Management of Shisham Mortality

- ❖ Selection and preparation of site - well drained sites with good aeration, take into account for site history of diseases
- ❖ Sanitation in the field of dead trees, stumps and roots
- ❖ Avoid pure plantation of shisham, go for mixed plantations
- ❖ Integrated disease management - *Trichoderma* spp., *Pseudomonas fluorescens*, fungicides, insecticides, fertilizers (particularly potassium)
- ❖ Selection of disease resistant clones and their propagation

- Control biotic pressure to check injuries to root system
- Raise plantations from seeds collected from natural stands
- Do not plant shisham where regular soil disturbance occurs such as along road sides and avenues
- Consider lowering of rotation age to 35-40 yrs

Some man-made causes of Shisham mortality



Creating a lake at Assan Barrage



Landfill over the basal area



Landfill over the basal area



Raw cow dung over the basal area



Cow dung cakes (*uppale*) over the basal area



Cow dung cakes (*uppale*) over the basal area

Jaggery making



Jaggery making



Jaggery making



Dumping over basal area



Dumping over basal area



Dumping over basal area



Blazing for marking the trees



Blazing for marking the trees



**Uncontrolled
lopping**

Searching for disease resistant and susceptible material

Hypothesis

In a heavily diseased area it is not unusual to find a few disease-free individuals

- **The freedom from infection may be due to escape or due to inherent character for resistance in the host**
- **Selection of such disease-free individuals and testing their progeny by raising them in the heavily diseased locality or through inoculations which will eliminate the escapes**

Bhitmera, Hissar

Screening against *Ganoderma Lucidum* root rot

Disease%	Clones in CSO	Clones in SSPA
< 10	-	304 (5.5%)
10 – 20	19, 87, 89, 194, 219, 255, 257, 262, 266	
21 - 30	34, 41, 66, 78, 90, 199	284
31 - 40	44, 80, 86, 93, 200	285, 297, 299, 300, 303, 305, 306
> 40	12, 20, 33,, 83, 84, 85, 93, 94, 101, 103, 123, 189, 192, 203, 242, 252, 259, 36, 57, 61, 81, 193, 196, 204 (72-78%), 88 (100%)	272, 276, 281, 288, 289, 290, 293, 294, 302, 307 291, 295, 298 (70 - 75%)

Score was worked out of 10 for each character and cumulative score for all the characters (height + girth + clear bole + disease resistance) out of 40. The best figure of the character was given a score of 10 and subsequently the score of other clones was worked out. (Cf. Nautiyal & Luna 2005, Dogra *et al.* 2006)

Clone No.	Total score
81	17.40
101	17.73
57	17.95
94	19.52
103	19.75

Susceptible clones

Clone No.	Total score
257	31.18
266	31.26
34	31.53
194	32.86
219	33.15
304	34.82

Resistant clones

Resistant clones at CSO Bhitmera

I = 219, 13 trees marked; II=194, 15 trees marked; III=266, 10 trees marked; IV=257, 6 trees marked

o o	000 000	000 000	000 000	000 000	000 000	000 000	000 000	000 000	000 000	000 000	000 000	000 000	000 000	000 000	000 000	000 000	o o
o o o	34	266 6 trees	20	80	78	57	84	41	19	192	86	000 000 000	000 000 000	000 000 000	000 000 000	000 000 000	o o o
o o o	61	242	33	66	198	257 3 trees	94	189	219 5 trees	255	85	90	252	262	82	101	o o o
o o o	203	193	89	259	204	194 8 trees	93	81	87	83	123	103	44	200	66	199	o o o
o o o	41	83	123	252	94	194 7 trees	33	242	257 3 trees	255	103	198	86	36	196	12	o o o
o o o	93	203	189	20	84	34	196	266 4 trees	36	204	12	44	88	61	90	25	o o o
o o o	199	101	193	51	192	81	87	219 8 trees	66	19	78	200	259	89	80	262	o o o



Clone 304 – Beat Uttrinalowala, Range Shyampur, Division Haridwar, UK



Clone 194 - Compt. Birpur 4A, Beat Bhambhar, Range Tulsipur, Division Gonda, UP



Clone 194 - Compt. No.2, Beat Hasanpur, Range
Tulsipur, Division Gonda, UP



Clone 266 - Compt. No.2, Beat Lalpani, Range
Rishikesh, Division Dehradun, UK

Disease resistance screening cont.....

Against *Fusarium solani* f. sp. *dalbergiae* – Resistant clones 103, 51, and 5021

Most susceptible clone 49 and 1003

Against *Ganoderma lucidum* – Resistant - Clones 33, 3, 14

Susceptible -Clone No. 2, 6, 10, 11, 16, 23 and 24

Thanks!