RHIZOCTONIA AERIAL BLIGHT - A DESTRUCTIVE NURSERY DISEASE AND ITS MANAGEMENT

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Introduction

In the wake of large-scale plantation programme launched in recent years in India under Social Forestry, Agroforestry and Farm Forestry, a large number of trees species are now being raised in the nurseries in different parts of the country. In a survey of nurseries at the Forest Research Institute, Dehra Dun, Karuapani, Satyanarayan and Lacchiwala under Dehra Dun Forest Division and Kalsi under Chakrata Forest Division, the author observed leaf blight in *Bauhinia variegata, Cassia fistula, Dalbergia sissoo* and *Populus deltoides* caused by *Rhizoctonia solani* Khun anamorph of *Thanatephorus cucumeris* (Frank) Donk.

Rhizoctonia is known to cause a number of diseases such as seed decay, root rot, hypocotyl and stem cankers, collar rot, bottom rot, crown and bud rot, aerial blights, storage rots and blemishes. A review of literature on *Rhizoctonia* diseases show that they are quite prevalent in agricultural and ornamental plants all over the world including India, the references are too many to cite. However, in forest tree species, the fungus is reported mostly to cause damping-off and is associated with bud killing and top rot in *Pinus resinosa* (Parmeter, 1970). Till 1980 there was no report on the occurrence of aerial blights in forest nurseries in India. Mehrotra (1982) recorded *Rhizoctonia* top flagging, a serious nursery disease of Khasi pine (*Pinus kesiya*) causing 60-80 per cent mortality of seedlings in a nursery at Burnihat, Assam. Later, the disease was also prevalent in Khasi hills, Meghalaya. Maria *et al.* (1985) and Sankaran *et al.* (1986) reported leaf blight in 3 forest tree species from South India. Mehrotra (1990) reported the occurrence of *Rhizoctonia* web blight in 20 tree species from North and North-eastern parts of India. The occurrence of the disease in different parts of the country shows wide distribution of the pathogen in forest nurseries and suggests the adaptability of the fungus under diverse environmental conditions. The present paper, fourth in series, describes the disease symptoms, epidemiology, mode of infection, damage and management of the disease which is recorded for the first time on the above mentioned tree species in India.

Materials and Methods

Periodic surveys were conducted in forest nurseries located in Doon Valley in Western part of Uttar Pradesh from 1989-91. Six nurseries, one located at New Forest, Forest Research Institute, two at Lacchiwala and one each at Karuapani and Satyanarayan under Dehra Dun Forest Division and Kalsi under Chakrata Forest

Division were surveyed during the rainy season (July-September). Seedlings of *D. sissoo, C. fistula* and *P. deltoides* were 5-6 months old whereas those of *B. variegata* were only 2 months old when the disease was first detected in July. Besides, the disease was also monitored in 3 yr-old plants of *P. deltoides* in an experimental plot at New Forest. All the isolates were cultured on PDA. Plain agar was used to induce formation of micro-sclerotia in the isolate from *D. sissoo*.

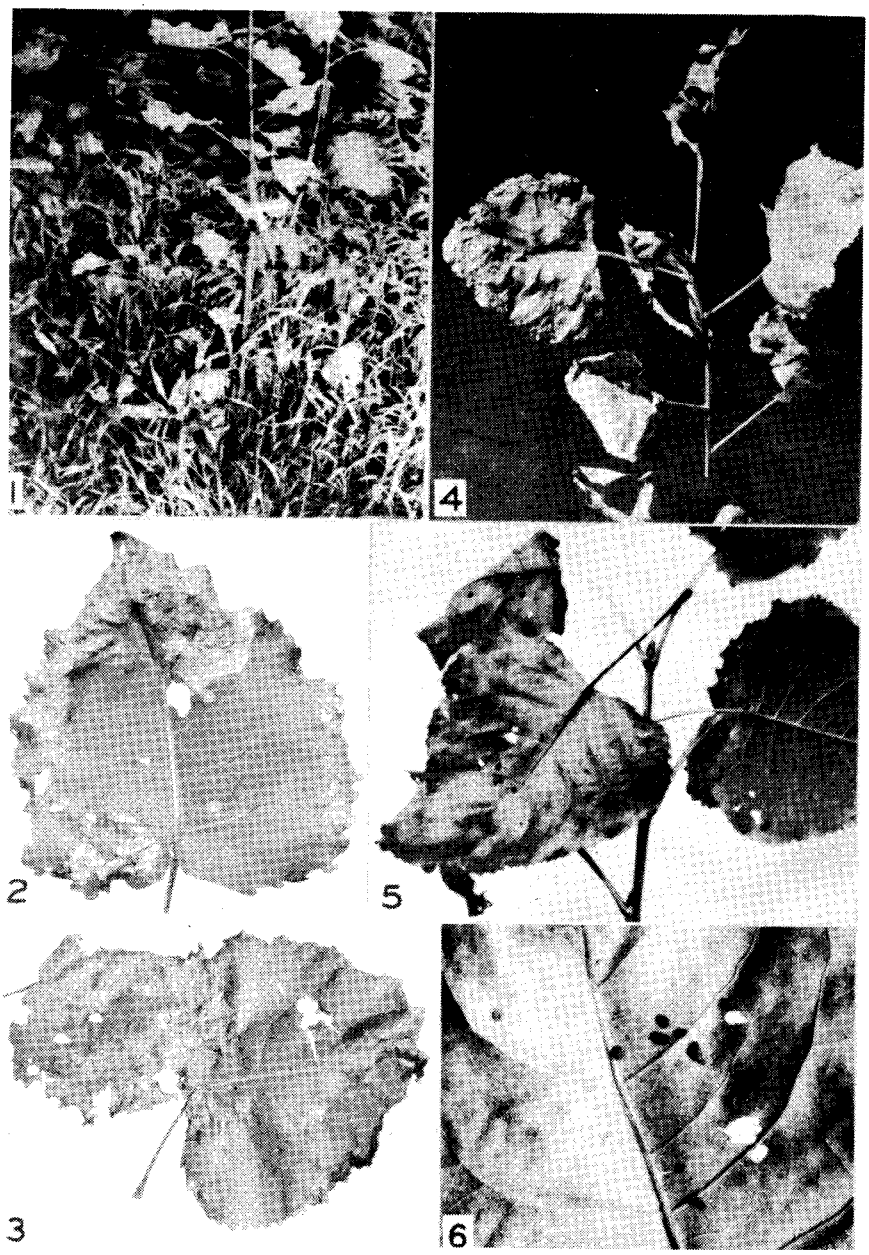
Results

Symptomatology : The disease appeared initially as greyish brown water-soaked spots or blotches which increased in size rapidly under warm and excessive humid conditions covering the entire leaf blade in a short time. The blighted leaves turned ragged brown in *P. deltoides* and *C. fistula* whereas in *B. variegata* the infected leaves turned chocolate brown and ultimately became papery interspersed with light brown to brown patches. The invaded tissues showed a network of hyphae running all over the leaf blade. They were macerated badly by the fungus and shed in pieces during rains resulting in irregular holes (shot holes) in *P. deltoides*. In *C. fistula*, the infected tissues between veins were shed leaving a skeleton network of veins. Both in *P. deltoides* and *C. fistula*, the blighted leaved crumpled during dry spell while it did not in *B. variegata* which retained the normal shape, but the blighted portions were occasionally shed leaving shot holes. In *D. sissoo*, the leaves became blighted and there was no shedding of infected portion.

Hyaline to brown mycelial strands running over healthy portion of the leaf blade adjacent to the invaded one was a distinctive feature of the disease. Another important feature was the presence of brown stromatoid aggregates usually on the lower surface of infected leaves and clusters of hyphae at the base of the petiole/petiolule. The adjoining leaves on blighting got webbed by the over-running fungal hyphae, hence the name web blight. The infected leaves often got detached even before they were fully blighted but they remained clinging to the plant due to cementing action of fungal hyphae which formed a sort of fungal cobweb. The fungus showed profuse vegetative growth during favourable conditions (excessive humidity) and produced sclerotia during dry spell on infected leaves as well as leaf litter both in *C. fistula* and *B. variegata*. In *P. deltoides*, typical large dark brown sclerotia formed on some of the infected plants while in most cases, sclerotia were absent suggesting the association of two different biotypes with the diseased plants. In *D. sissoo* the fungus produced micro-sclerotia on the stem, branches, petiolule and leaflets and they were at first white and later turned brown. The disease spread laterally from plant to plant through contact of the overlapping foliage and, therefore, group blighting of plants was a common sight in the nursery and also in experimental plots in case of *P. deltoides* (Figs. 1-12).

Causal Organism : The causal organism in all the four tree species was identified as *Rhizoctonia solani*. Three biotypes of the fungus were identified which differed morphologically. The biotype (TS) associated with *C. fistula* and *B. variegata* formed typical large dark brown sclerotia on infected leaves and also produced them on potato dextrose agar medium. The biotype (MS) associated with *D. sissoo* produced micro-sclerotia on infected plant parts. Of the two biotypes associated with *P. deltoides* one produced typical large dark brown sclerotia

Figs 1-6



Leaf web blight of *Populus deltoides* caused by *Rhizoctonia solani* (Biotype WTS) : 1. A view of the nursery bed with infected seedlings and weeds. 2. A blighted leaf. 3. Two infected leaves webbed together. (Biotype TS) : 4. A seedling showing infected leaves. 5. Infected leaves; one of them clinging to other leaves on detachment. 6. An infected leaf showing typical dark brown sclerotia (TS).

Figs 7-12

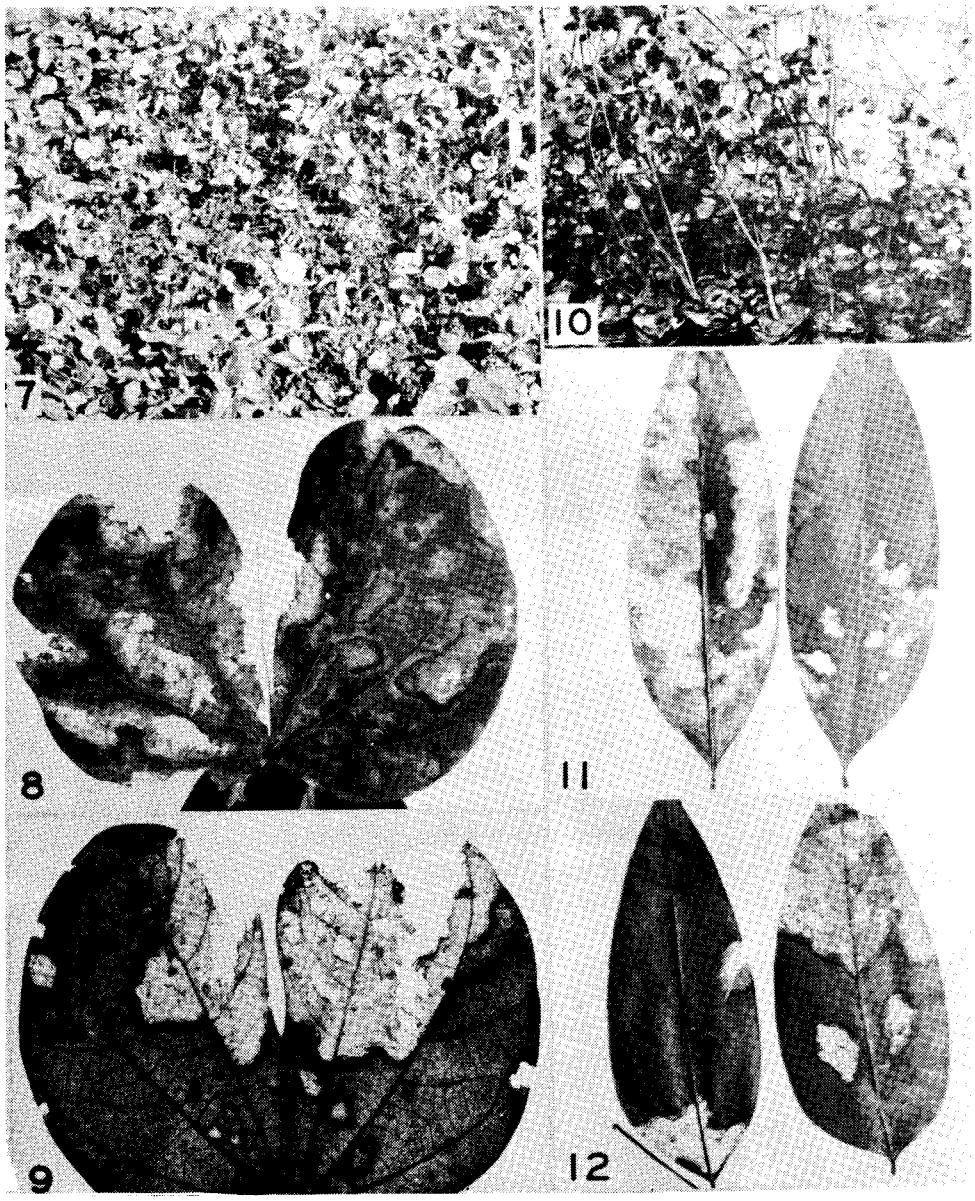


Fig 7-9. Leaf web blight of *Bauhinia variegata* caused by *Rhizoctonia solani* (Biotype WTS). 7. A view of the nursery bed with showing blighted seedlings. 8-9. Infected leaves showing sloughed off necrotic tissues.

Fig. 10. A view of blighted seedlings of *Dalbergia sissoo* infected by *Rhizoctonia solani* (Biotype MS).

Fig. 11-12. Blighted leaves of *Cassia fistula* infected by *Rhizoctonia solani* (Biotype TS) showing sloughed off necrotic tissues and intact veins and veinlets.

(TS) on infected leaves and the other biotype (WTS) did not produce sclerotia. However, it produced light brown and relatively much less compact sclerotial structures on PDA which were different from the typical large dark brown sclerotia produced by the biotype (TS). It is this latter biotype which was quite prevalent and more damaging to plants.

Pathogenicity : Pathogenicity tests were conducted successfully following the Koch's postulates.

Infection : The pathogen is considered as a primitive parasite with simple food requirements and a high mycelial growth rate (Garrett, 1960). With this arsenal of activity and a quite broad host range including weeds (Mehrotra, 1989), it is common to find the organism in forest nurseries. The fungus is known to overwinter in the form of sclerotia and fungal hyphae in the soil or within the debris tissues which are the source of natural inoculum. Also the infected plants, if retained in the nursery in the following year, may act as the source of infection due to reactivation of the fungus (lodged on the stem and branches) on return of warm and humid conditions during monsoon rains. The fungal hyphae may grow and progress up the stem and also infect the bottom leaves to the ground. Besides, the soil particles carrying the fungal hyphae may get deposited on aerial plant parts by splashing during rains and the fungus may attack the plants. Once the infection is established, the fungus can spread vertically from leaf to leaf attacking more and more foliage. The disease escalates under excessive humid conditions following heavy and incessant rains for a couple of days and maximum damage to seedlings may be caused within a short span of 2 to 3 weeks. Free water on the surface of aerial plant parts favours rapid spread of the fungal hyphae. Both vertical and lateral spread of the disease from plant to plant explains why the disease is so much damaging within a short period. Weeds such as *Ageratum houstonianum, Bidens biternata, Setaria glauca* and *Arundinella nepalensis* which grow commonly in Doon Valley and are highly susceptible to web blight, may also serve as the source of infection and play a role in disease epidemic.

Damage : The disease was highly damaging to the foliage as it caused premature defoliation at the peak of the growing season. However, the disease incidence and damage varied from nursery to nursery being more when they were raised in beds than in polypots as also observed earlier for this disease in *Azadirachta indica, Melia azedarach* and *Pinus kesiya* (Mehrotra, 1990).

In *B. variegata*, the disease incidence was maximum in one of the nurseries at Lacchiwala where 80 per cent seedlings got diseased and defoliation varied from 20-100 per cent. On the other hand, in another nursery at Lacchiwala the disease incidence varied from 10-30 per cent and defoliation ranged from 10-40 per cent. However, 2 months old seedlings of *B. variegata* in beds showed maximum damage and they were killed in large numbers and mortality rose to 15-20 per cent within a short period of 2-3 weeks. In *Cassia fistula*, the disease incidence at Lacchiwala varied from 10-15 per cent and defoliation was to the extent of 90-100 per cent in seedling raised in polypots. However, the seedlings raised directly in the beds in the same nursery generally showed higher incidence of the disease (60-80 per cent) and all the infected seedlings defoliated almost completely. The

heavily defoliated seedlings did not attain any appreciable growth till the end of the growing season.

In *D. sissoo* the incidence of the disease was 40 per cent and defoliation ranged from 30-75 per cent. It is for the first time the biotype producing micro-sclerotia was detected in one of the plots in a nursery at Lacchiwala. This biotype was less damaging to seedlings as compared to the biotype (TS) usually found attacking plants in the nurseries in Doon Valley (Mehrotra, 1991).

In *P. deltoides* about 12 per cent of the 5000 plants in the experimental plots were diseased due to the biotype (WTS) which was quite frequent in the area. The extent of damage to the foliage varied from 20-70 per cent. Generally, it is the bottom leaves which were severely damaged and shed prematurely. On the other hand, attack on leaves of middle and upper branches was poor to severe. In contrast, the other biotype (TS) was restricted in the area and the incidence of the disease was only 5-7 per cent. However, defoliation caused by this biotype was relatively more (30-90 per cent) as against 20-70 per cent by the biotypes (WTS). In *P. deltoides* the disease was insignificant during the first year but increased considerably during the next 2 years. This is attributed to significant increase in the quantum of inoculum which constitutes infected plant debris and also the stem and branches of the infected plants on which the fungus is likely to overwinter and resume activity on return of favourable conditions during humid months in the following year. Since grasses and other weeds in the area show high susceptibility to the disease and play a definite role in disease escalation, the disease is likely to maintain an upward trend if remains unchecked (Table 1).

Epidemiology : Warm and humid conditions are necessary for disease development. In India the pre-monsoon rains start in the first week of June. The disease usually develops in mid-July when regular monsoon sets in and excessive humid conditions prevail. It has been observed that the disease intensity increases with increase in frequency and intensity of rains. Heavy rains with intermittent sunshine worsens the disease situation. The maximum damage to the foliage occurs between mid-July to end-August, declining thereafter from the first week of September, and by September end the activity of the fungus ceases with lowering of temperature and decreasing of relative humidity in the atmosphere.

Management of the Disease : Integrated control of the disease is recommended which includes measures such as : (1) Sanitation to remove the infected seedlings as soon as the disease symptoms appear. This will prevent lateral spread of the disease through contact of the over lapping foliage. (2) Weeding to remove alternate hosts which otherwise may serve as a potential source of infection, and (3) Use of Bayleton (0.08%), a systemic fungicide, as foliar spray in case the disease is not brought down below the economic injury level by the first two methods. The above fungicide has been found highly effective in controlling *Rhizoctonia* leaf web blight in *Albizia lebbek* (Mehrotra, 1995).

Discussion

The results of the present investigations show that the pathogen, *R. solani* causing leaf blight is represented by three morphologically different biotypes. The present as well as the earlier findings (Mehrotra, 1990) show that the biotype

Table 1

Incidence, extent of defoliation and mortality in tree species due to Rhizoctonia aerial blight

Species	No of plants	Disease Incidence (%)	Defoliation (%)	Mortality (%)	Places where disease was recorded
Bauhinia variegata	1000	80	20-100	-	Soil Conservation Nursery, Lacchiwala
	1000	10	10-25	-	Territorial Nursery, Lacchiwala
	1000	30	15-40	-	
	1000	15		15	
	1000	20		20	Soil Conservation Nursery, Lacchiwala
Cassia fistula	1000	10	90-100	-	Soil Conservation Nursery, Lacchiwala
	1000	15	90-100	-	
	1000	60	100	-	Soil Conservation Nursery Lacchiwala
	1000	80	97	-	
Dalbergia sissoo	5000	40	30-75	-	Territorial Nursery, Lacchiwala
Populus deltoides	100	5	30-90	-	Range Office, New Forest
	100	7		-	Brandis Road and Range Office, New Forest
	5000	12*	20-70	-	

* Data based on 50 plants in each of 10 sub-plots

(TS) is quite prevalent in the nurseries whereas as the biotype (MS) occurs infrequently in the nurseries. The third biotype (WTS) has been recorded for the first time on *P. deltoides* and is widespread. The first two biotypes show no host specificity as they have been recorded on other tree species as well. Further cross inoculation studies carried out by Mehrotra (1990) also lend support to this contention. The capability of the biotype (WTS) to attack grasses and other weeds on experimental plots of *P. deltoides* show its wide host range. This biotype, however, differs from the other two in the extent of damage to the foliage. It appears to be most damaging because of its fast spreading mycelium over the infected plants. The biotype (MS) though produced micro-sclerotia abundantly in nature failed to do so when cultured on PDA. Exner (1953) and Yang *et al.* (1990) have also reported that *R. solani* causing foliar blight in soyabean produced micro-sclerotia in nature but not on PDA.

Epidemiological studies carried out showed that prolonged periods of high relative humidity and leaf wetness in conjunction with moderate temperature as prevalent during humid months in India

were conducive to infection and disease development. Maria *et al.* (1985) and Sankaran *et al.* (1986) also reported warm and humid conditions to be favourable for severity of the disease in hardwood species caused by *R. solani*.

SUMMARY

The paper records for the first time the occurrence of leaf blight, a new disease of *Cassia fistula* Linn., *Bauhinia variegata* Linn., *Dalbergia sissoo* Roxb. and *Populus deltoides* Marsh caused by *Rhizoctonia solani* Khun anamorph of *Thanatephorus cucumeris* (Frank) Donk in the nurseries in Western Uttar Pradesh. Of the three morphologically different biotypes of the fungus found on diseased plants, one formed typical dark brown sclerotia, the other produced micro-sclerotia, while the third did not produce sclerotia. The disease caused blighting and webbing of leaves by the fungal hyphae running over the infected aerial parts and forming cobweb like structure. Stromatoid aggregates developed on the surface of infected leaves and clusters of hyphae formed at the base of the petiole or petiolule. The disease caused premature defoliation and group infection of seedlings due to lateral spread of the disease through contact of the overlapping foliage of the adjoining seedlings. Epidemiology of the disease, mode of infection and extent of damage to the seedling crop are described and measures for management of the disease outlined.

राइजोक्टोनिया बायव्य अंगमारी - रोपणियों का विनाशकारी रोग और उसकी रोकथाम

एम०डी० मेहरोत्रा

सारांश

इस अभिपत्र में प्रथम बार *कैसिया फिस्टुला* लि०, *बौहीनिया वैरिगेटा* लि०, *डलबर्गिया सिस्सु* राक्स० और *पोपुलस डेल्टायडिस* मार्श पर पश्चिमी उत्तर प्रदेश की रोपणियों में *थानाटेफोरस कुकुमेरिस* [फ्रैंक] डोक के खुन प्रकायान्तर *राइजोक्टोनिया सोलानी* से होने वाली पत्र अंगमारी को अभिलिखित किया गया है । रुग्ण पादपों पर पाए गए कवक रचनाकारिकीय दृष्टि से भिन्न तीन जीव प्रारूपों में से एक से प्रारुपिक प्रकार के गहरे भूरे जालाश्म बने, दूसरे से अणुजालाश्म बने तथा तीसरे से जालाश्म नहीं बने। रोग में कवक सूत्रों के कारण पत्तियों की अंगमारी और जालीकरण हुआ जो संक्रमित बायव्य भागों के ऊपर से होकर जा रहे थे और जिससे मकड़ी के जाले जैसी संरचना बन गई थी । संक्रमित पत्तियों के स्तर पर एधाराभ समूहक विकसित हुए और पर्णवृन्त या पर्णवृन्तक के आधार पर कवक सूत्रों का झुण्ड बन गया । रोग से समय-पूर्व पत्तियां झड़ गई और पास-पास लगे पौधों की एक दूसरे पर जाती पत्तियों के परस्पर सम्पर्क से पार्श्विक फैलाव का काम होने से पौधों के समूह में संक्रमण फैल गया । इस बीमारी का व्यापक रोग-विज्ञान संक्रमण होने का ढंग तथा पौधों को होने वाली क्षति की सीमा तथा रोग की रोकथाम की रूपरेखा इसमें बताए गए हैं ।

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