DISEASES OF MULBERRY-A REVIEW

BY

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Abstract

The literature on various diseases of mulberry, from throughout the world has been reviewed. This paper reviews available information on a number of mulberry diseases and their casual organisms comprising fungi, viruses, bacteria and phanerogamic parasites. Mulberry mosaic virus was found to cause heavy reduction in leaf yield and distortion in the cocoons with inferior silk when silk worms were fed on infected leaves.

Introduction

Mulberry (Morus spp.) is generally grown for sericulture and sports manufacturing industries in Pakistan. It is susceptible to many diseases that impair both quality and quantity of the foliage, which serves as forage for silk worm larvae. The stem and root diseases have a direct effect on health of the trees and are responsible for loss in timber and for causing mortality in the infected plants. The literature on mulberry diseases occurring in the world is, therefore, reviewed that would go a long way in the successful cultivation of mulberry in the country. These have been grouped into foliage diseases, stem diseases, root diseases and fruit diseases and information on their symptoms, causal organisms and hosts is provided in this article.

A. FOLIAGE DISEASES

Leaf spots

Important leaf diseases of mulberry are spots caused by three species of Cercospora, namely, C. missoriensi Wint., C. mori Hara and C. moricola Cke. C. missoriensis causes dull brown to almost black spots on lower surface of M. alba leaves in U.S.A. C. mori forms mould-like, olivaceous to dark fruiting patches on the lower surface of this and other species of mulberry in China, Taiwan, Japan, U.S.A. and Zaire. C. moricola causes leaf spots with gray to tan centres and dark purple to black border on both sides of leaves of M. alba in Brazil, India, U.K., U.S.A. and Somaliland (Ahmad, 1956; Spaudling 1961; Vasudeva, 1963; Hepting, 1971).

Cylindrosporium maculans (Allesch.) Jacz. causes serious leaf spot of M. alba in Albania, Denmark, Poland, Russia and Yugoslavia. The disease is successfully controlled by chemicals (Spaudling, 1961; Chanturiya and Gvinepadze, 1972).

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Mycosphaerella mori Wolf is responsible for leaf and fruit spot diseases in M. alba, M. indica and M. nigra throughout the world. The fungus is known as Septogloeum mori Briosi and Cavara in its imperfect state (Spaudling, 1961; Zakaullah et al., 1987). Infection appears as small dark spots which gradually become larger, irregular and pale brown in colour. Heavy infection may cause severe defoliation (Browne, 1968). Mycosphaerella indica Vishwanathan causes leaf spot in M. alba in Poona, India (Tandon and Chandra, 1963, 64).

Pseudomonas mori (Boyer and Lamb.) Stevens causes leaf spot and elongated lesions on old twigs of M. alba, M. australis, M. indica and M. nigra in Australia, Brazil, East and South Africa, Europe, Japan, Korea, North America and Turkey. Infection results in stunting and die-back of diseased plants. In wet weather, bacteria may ooze from infected twigs (Peace, 1962).

Other leaf spot diseases recorded on species of Morus are Ascochyta morifolia Saw. on M. alba in Taiwan; Cercosporella mori Peck on M. alba in U.S.A.; Closterosporium mori Syd. on M. alba in China and Japan; Phyllosticta kuwacola K. Hara on M. alba in Japan; P. morifolia Pass. on M. alba in India (Spaudling, 1961; Tandon and Chandra, 1963, 64; Browne, 1968; Sarbhoy et al. 1975).

Powdery mildews

Four species of Phyllactinia viz; P. corylea, P. guttata, P. moricola and P. suffulta are recorded on different Morus species. P. corylea and P. suffulta are reported as synonyms of P. guttata (Browne, 1968) which forms white, powdery coatings on leaves of Morus sp. in Indo-China; M. alba in China, India, Japan, Pakistan and Russia and on M. nigra in India. P. moricola attacks M. alba and M. australis in China and Japan (Spaudling, 1961; Browne, 1968).

Uncinula mori Miyake, the incitant of Powdery mildew, forms a coating on lower surface of leaves in M. alba in Japan and Russia and on upper surface of leaves of Morus sp. in Kulu, India (Spaudling, 1961; Gill et al., 1961).

Leaf rusts

Three species of rust are known to attack mulberry leaves. Aecidium mori Barcl. causes yellow infection spots on leaves of M. alba in India, China, Japan and Pakistan; M. indica and M. serrata in India and Pakistan; M. australis in China, Taiwan and Japan and Morus sp. in India and Japan. In case of heavy infection, the entire leaf surface is covered but the damage is small as the defoliation due to rust occurs about the same time as the normal leaf fall (Spaudling, 1961; Bakshi and Singh, 1967). Crotelium fici (Hoehn.) Arth. produces powdery, cinnamon-brown rust pustules scattered on lower surface of M. alba in Phillipinies, Tanzania and other species of Morus in Madagascar and Guatemala (Spaudling, 1961). Keuhneola moricola P. Henn. attacks M. alba leaves in China (Spaudling, 1961).

Virus diseases

Mulberry mosaic virus is reported on Morus species from China, Japan, Puerota Rico, Thailand and U.S.S.R. under various names such as mulberry dwarf, curly little leaf virus and mulberry small leaf curl. The symptoms exhibited are cupping, downwards of leaves, stunting of branches of entire tree and sometimes resulting in the death of affected leaves. The disease is transmitted through grafting and by insect vectors (Spaudling, 1961). In China, infection of 50 to 80% of trees resulting in 70% reduction in leaf yield has been reported. Silkworms fed on infected leaves produce distorted cocoons and yield inferior silk (Faan et al., 1964). A similar dwarfing disease is reported on mulberry in Japan in which mycoplasma-like organisms are observed. Recession of symptoms was obtained by using antibiotics but the symptoms reappeared when the application was stopped (Ishiie et al ., 1967. Ishiie, 1970).

Another virus disease, known as mulberry ring spot virus of leaves showing ring spot and filiform leaf symptoms is reported from Japan (Tsuchizaki et al., 1971).

B. STEM DISEASES

Die-backs

Hendersonula toruloidea Nat. causes serious die-back of M. alba in Pakistan. The fungus infects branches and twigs in the crown. Infected branches are killed back and the process continues till the pathogen travels to the base of the tree. At this stage, the affected tree gives sable hair brush-like bushy appearance. Infection may also occur directly on the main stem. Other symptoms of the disease are appearance of water - soaked, slightly depressed brown areas on the stems below the bark cracks and peels off. Black masses of spores appear below the infected bark.

In advanced stages of the disease, the pathogen attacks the sapwood causing grayish-black discolouration. The disease spreads through air-borne spores (Khan, 1955). The pathogen attacks the cambial region of a wide range of hosts often following injury by insolation.

Cankers

Twig and branch canker commonly known as Gibberella twig canker is reported on M. alba and M. nigra and is widespread in Australia, Taiwan, Germany, Japan, Netherlands, New Zealand, U.K. and U.S.A. The causal organisms have been variously identified as Fusarium lateritium Nees, F. lateritium var. mori D.W. and R. and F. mori Desm. The pathogen infects through wounds, causing cankers which may girdle and kill the infected branches. The conidial state appears as redish-brown pustules followed latter by the blackish perithecia of the perfect state (Spaudling, 1961; Peace, 1962 and Hepting, 1971).

Nectria cinnaborina Fr. causes canker in Morus sp. in France, Japan and New Zealand. The pathogen is known to exist in strains which may vary from purely saprophytic to aggressively parasitic. It enters the host through buds injured by frost. The hyphae grow in the dead cells and from there enter into the sound tissues (Butler, 1918).

N. coccina Fr. and N. galligena Bres. cause perennial target canker on Morus alba in U.S.A. Small, red perithecia of the parasite appear under bark crevices around the margins of the cankers (Hepting, 1971).

Sphaeropsis mori Berl. is reported to cause canker of M. alba in Italy and Tanzania. The fungus also infects twigs causing lesions and die-back (Spaudling, 1971).

Thyriostroma mori (Nomura) Hoehnel (syn.Coryneum mori Nomura) causes serious cankers and die-back of young stems in M. alba in Pakistan and India. The fungus infects through wounds at points injured by frost and snow (Butler, 1918).

Blights

Gibberella lateritia (Nees) Snyd. & Hans. causes lesions and blight of buds on M. alba in Japan (Spaudling, 1961).

Heart rots

Heart rot fungi on mulberry include Fomes formentarius Kickx on Morus sp. in Portugal; F. robiniae (Murr.) Sacc. & D. Sacc. on M. alba in Japan; F. senex (Nees & Mont.) Cke. on Morus sp. in India and on M. alba in Pakistan; Ganoderma applanatum (Wallr.) Pat. on M. alba and Morus sp. in France, Germany, India and Portugal and Polyporus squamous Fr. on M. alba in Germany (Spaudling, 1961; Browne, 1968).

Other parasitic fungi recorded on twigs, branches and stems of Morus are Claudopus nidulans (Fr.) P.1K. on Morus sp. in Japan causing sapwood rot; Collectorichum moricola Vishw. on M. alba in India causing twig blight; Corticium salmonicolor B. Br. on M. australis in Taiwan; M. indica in Tanzania causing twig blight and stem cankers; Cytodiplospora mori I. Miyake on M. alba in Japan causing twig blight; Cytospora atra Sacc. on M. alba in U.K. causing die-back; Physalospora obtusa (Schw.) Ske. on M. alba in eastern United States causing cankers on stem and branches; Sclerotinia sclerotiorum (Lib.) de Bary causing die-back of young shoots in Bulgaria on an epidemic scale and is possibly favoured by wet spring and summer, Thyrococcum sirakoffii Bub. on Morus sp. in Central Europe causing die-back of twigs and cankers on stems and branches and Valsa abiens (Fr.) Fr. on M. alba in Japan causing die-back (Spaudling; 1961; Peace, 1962).

Phanerogamic parasites

Three leafy mistletoes recorded on Morus species are Dendrophthoe falcata (L.F.) Ettingsh. and Loranthus sp. on M. alba; L. pulverulentus on M. alba and Viscum album L. on M. alba and M. nigra (Browne, 1968; Zakaullah et at., 1984)

C. ROOT DISEASES

Rootrots

Rosellinia necatrix (Hartig) Berl. causes white root rot of mulberry seedlings and trees in France, Italy and Japan. The pathogen attacks root surface in young trees, while in older trees, infection is mainly through lenticels. The vascular tissues are killed in advance before conlonization by the pathogen (Sakuri, 1952). The fungus is favoured by overcrowding of seedlings in the nursery. Infected saplings can be successfully disinfected by hot water treatment at 45oC for one hour or at 47oC for 40 minutes (Matuo and Sakuri, 1954).

R. aquila (Fr.) de Not. causes rootrot of young mulberry trees in France (Spaudling, 1961). The pathogen is favoured by wet soils.

Helicobasidium monpa Tanaka is one of the most serious root diseases reported from China, Taiwan, Japan and Korea. The pathogen attacks slender roots which turn yellowish to blackish brown, become soft and decayed. In severe attack, the cambium of the large roots may also be killed. The pathogen produces purple rhizomorphs which on reaching the base of trees develop into mycelial mats or fruit bodies. The leaves become small accompanied by early defoliation and subsequent death of affected trees when most of the roots are decayed. The pathogen can live as a saprophyte on plant debris in soils (Ito, 1949; Spaudling, 1961).

Diplodia morina causes death of roots in M. alba in India. The pathogen is reported to kill branches as well (Spaudling, 1961).

Other pathogens recorded on mulberry are Armillaria mellea (Vahl.) Quel. causing rootrot of debilitated trees of M. alba in U.S.A. and Morus sp. in France and Japan; Botrytis cinerea Pers. ex Fr. causing gray mould blight of M. alba seedlings in Russia; Ganoderma lucidum (Leyss.) Karst. causing root rot of M. alba in Pakistan and India and Macrophomina phaseolina (Tassi) G. Goid. on M. alba in India (Butler and Bishy, 1960); Spaudling, 1961; Browne, 1968; Hepting, 1971). Phomopsis moricola, Verticillium dahliae Kleb and Fusarium sp. are recorded from Russia causing infection at root collar region of mulberry tree (Goncharenko, 1968).

Diseases Of Fruits

Ciboria corunculoides (Siegler & Jenkins) Whet. causes popcorn disease of M. alba in U.S.A. Another species, C. shiriana (P. Henn.) whet., causes similar disease in M. alba and M. australis in China, Taiwan and Japan. Both pathogens are considered distinct from each other but produce identical symptoms. The infection results in hypertophy of separate drupelets of fruits where the fungi produce sclerotia which overwinter on the fallen fruits to become active in the next spring (Spaudling, 1958, 1961).

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LITERATURE CITED

1.....Ahmad, S. 1956. Fungi of West Pakistan. Monograph No.1, Biological Society of Pakistan. Government College, Lahore Pakistan. pp. 126.

2. Browne, F.G. 1968. Pests and diseases of Forest plantation trees. 1330 pp. Clerendon Press, Oxford.

3. Butler, E.J. 1918. Fungi and diseases in plants. 547 pp. Thacker, Spink & Co., Calcutta.

4. Butler, E.J. and Bisby, G.R. 1960. The fungi of India, 552 pp. Revised by R.S. Vasudeva. Indian Coun. Agric. Res. New Delhi.

5. Chanturiya, N.N. and Gvinepadze, M.S. 1972. Trials of antibiotics in the control of leaf spots of mulberry Mikologiya i Fitopathologiya 6: 533 - 535. [R.P.P. 52. no 2991, 1973.]

6. Faan. C., Lai, W.J., Chan, D.S. and Tom, W.F. 1964. A preliminary study of the incidence and transmission of mulberry dwarf disease in kwangtung province. Acta phytopath. sin. 7: 151 - 156.

7. Gill, H.S., Munjal, R.L. and chona, B.L. 1961. Studies on powdery mildews from India. II.Indian Phytopathology 14: 174 - 178.

8. Goncharenko, L.K. 1968. The incidence of various causes of mulberry root collar infection and their relation to different conditions of nutrition. Shovkivnitstivio Resp. mizhvid Tem nauk. Zb. 1968 (1), 2631. [R.A.M. 48. no. 1242, 1969].

9. Hepting, G.H. 1971. Diseases of forest and shade trees of the United States. USDA. Handbook No. 386, 243 - 245.

10. Ito, K. 1949. Studies on 'murasaki-monpa' disease caused by Helicobasidium monpa Tanaka. Bull. For. Exp. Sta. Tokyo 43: 126. [R.A.M. 30. no. 337, 1951].

11. Ishiie, T. 1970. Mycoplasma-like organism, causal agent of mulberry dwarf disease. Jap. Agric. Res. Q. 5: 48-53. [R.P.P. 51, no. 2697, 1972].

12. Ishiie, T., Doi. H., Yara, K. and Asuyama, H. 1987. Suppressive effects of antibiotics of tetracycline group on symptom development of mulberry dwarf disease. Ann. Phytopath. Soc. Japan 33:267 - 275. [R.A.M. 47, no 656, 1968.]

13. Khan, A.H. 1955. A new disease of mulberry in the forest plantations of the Punjab. Pak. J. Sci. Res. 7: 92 - 99.

14. Matuo, T. & Sakuri, Y. 1954. Hot water disinfection of the sapling of the mulberry tree infected by Rosellinia necatrix (Hart.) Berl. and the situation of the isolation ditch preventing the development of the disease in the mulberry farm. J.Seric. Soc. Tokyo 23: 271 - 277.

15. Peace, T.R. 1952. Pathology of trees and shrubs with special reference to Britain. 753 pp. Clarenon Press Oxford.

16. Raychaudhuri, S.P., Chatterjee, S.N. and Dhar, H.K. 1961. Preliminary note on occurrence of yellow net vein disease of mulberry. Indian Phytopathology 15: 187 - 189.

17. Sarbhoy, A.K., Girdari Lal and Varshney, J.L. 1975. Fungi of India 1967 - 71. 148 pp. Navyung Traders, New Delhi.

18. Sakuri, Y. 1952. Pathologico-anatomical observations on the white rootrot of mulberry trees caused by Rosellinia necatrix (Hart.) Berl. Res. Rep. Fac. Text Sihinshu Univ. 2, 15-26. [R.A.M. 34: no 796, 1955].

19. Spaudling, P. 1961. Foreign diseases of forest trees of the World.Agric.Handbook No.197, U.S. Dept. Agric.361p.

20. Spaudling, P. 1958. Diseases of foreign forest trees growing in the United States. Agric. Handbook No.39, U.S. Dept. Agric. 118 pp.

21. Tandon, R.N. and Chandra, S. 1963-64. Supplement to the list of Indian Fungi

1957-1962. 246 pp. University of Allahabad Publication, Senate House, Allahabad.

22. Tsuchizaki, T., Hibino, H. and Saito, Y. 1971. Mulberry ring spot virus isolated from mulberry showing ring spot symptoms. Ann., Phytopath. Soc. Japan 37: 266 - 271. [R.P.P. 51, no. 2697-1972].

23. Zakaullah; Haque, M.I. and Khial, B. 1984. Loranthus parasitism - A challenge to the development of economic tree resource in the Rawalpindi east region. Pakistan J. For. 34(2): 101-109.

24. Zakaullah; Ara, J. and Jabbar, A. 1987. New hosts of some parasitic fungi from N.W.F.P., Northern Areas and Azad Kashmir. Pakistan J. For. 37(3): 135-139.