

PATHOGENS FROM THE AZORES, MADEIRA, AND CANARY ISLANDS AS BIOCONTROL AGENTS OF *MYRICA FAYA* (MYRICACEAE) IN HAWAII

By D. E. GARDNER¹ & C. S. HODGES, JR.²

ABSTRACT. *Myrica faya*, a component of the native laurosilva forest of the Azores, Madeira, and Canary Islands, was introduced to Hawaii during the late 1800s where it has become a noxious weed. Mechanical removal and chemical applications have been used to control *M. faya* in limited areas, but widespread infestations may require biocontrol. In addition to insects, several fungi from the native habitats of *M. faya* are, or have been under investigation as biocontrol agents. These include *Ramularia destructiva*, *Nectria galligena*, *Cryphonectria* sp., and *Dothiorella* sp.

Myrica faya AITON (MYRICACEAE) was introduced to Hawaii during the late 1800s by immigrants from the Azores and Madeira and has become an aggressive invader of native forest habitats in its new location (SMATHERS & GARDNER, 1979). Efforts to control this species in Hawaii, which is now considered a noxious weed, have included mechanical eradication on a local basis, and use of herbicides on a wider scale (KIM, 1969; WALTERS & NULL, 1970; GARDNER & KAGELER, 1982). These labor-intensive methods have proven useful for control in limited, high value areas, but have not been practical in the control of *M. faya* over its continually expanding range in upper elevation forests. The problem is exacerbated by nonnative birds and feral pigs, which are readily attracted to the fleshy fruit and appear capable of spreading undigested seeds throughout forest habitats (WOODWARD *et al.*, 1990; STONE, 1985).

Classical biocontrol, through which natural enemies (*i.e.*, arthropods and disease organisms) are sought in the native habitats of introduced species, has been successful in the control of other weed problems in Hawaii (GARDNER, 1990). Exploratory trips for this purpose were made to the Azores, Madeira, and the Canary Islands by entomologists and plant

¹ National Park Service, Cooperative Park Studies Unit, Department of Botany, University of Hawaii at Manoa, Honolulu, Hawaii 96822, USA

² Department of Plant Pathology, North Carolina State University, Raleigh, North Carolina 27695, USA

pathologists from Hawaii beginning in the mid 1950s and continuing until the present (KRAUSS, 1964; HODGES & GARDNER, 1985; GARDNER & HODGES, 1990). Insects found associated with *M. faya* were listed by KRAUSS (1964). Current status of biocontrol of *M. faya* with insects is discussed more fully by MARKIN (1991) and MARKIN AND SILVA (this volume).

The pathogens found to date represent fungi associated with stem, branch, and leaf diseases, some of which apparently have not been reported from the Atlantic islands prior to these biocontrol investigations. A twig dieback caused by *Dothiorella* sp. (FUNGI IMPERFECTI: COELOMYCETES), possibly *D. vulgaris* DE TRAV., was found on Madeira by earlier exploratory entomologists (F. BIANCHI, unpublished correspondence), who remarked that the disease was perhaps the most impressive of any natural controls for *M. faya* they had encountered. Consequently, a plant pathologist near Lisbon was contracted by the then Hawaii Territorial Board of Agriculture to investigate the pathogen further. Unfortunately, whereas the virulence of the fungus was confirmed on *M. faya*, other trees were also found susceptible, including several trees of economic importance in Hawaii (AZEVEDO, 1960). Further interest in this pathogen as a biocontrol agent was subsequently suspended. Although KRAUSS (1964) was principally interested in the insect fauna of *M. faya*, he did report a twig blight caused by *Ramularia destructiva* PHIL. & PLOWR. (FUNGI IMPERFECTI: HYPHOMYCETES), in Madeira and the Canary Islands. The fungus previously had been known from *M. gale* L. in the United Kingdom and the European Continent, and also from North America.

Our more recent exploration of the Atlantic Islands (HODGES & GARDNER, 1985) has confirmed the occurrence of *R. destructiva* in Madeira and the Canaries, and has expanded its known range to the Azores as well. The disease is characterized by a severe crooking of the infected twig, which may be killed back 5-15 cm from the tip. White, cottony-appearing sporodochia are produced on the surface of diseased tissue.

During earlier exploration, BIANCHI (unpublished correspondence) reported bark cankers on trunks and branches of *M. faya*, the cause of which was not evident. We found such cankers, often causing severe disruptions of bark and cambial tissue, associated with minute orange fruiting bodies at canker margins, suggesting that the cankers were caused by *Nectria* spp. The fungus was cultured and later identified as *N. galligena* BRES. (ASCOMYCETES: NECTRIACEAE) (GARDNER & HODGES, 1990). Although this fungus is known to attack a variety of woody plants, we did not observe it on any shrub or tree species other than *M. faya*, which was frequently prominently infected in the Atlantic Islands.

A second bark canker, apparently unreported previous to our exploration, was found infrequently on the islands of Pico, Terceira, São Miguel, and Faial in the Azores, and on Madeira, associated with an unknown species of *Cryphonectria* (ASCOMYCETES: DIAPORTHACEAE). The infected area, often found on the trunk near ground level, was typified by sunken, cracked bark with an orange cast. The cankers somewhat resembled those caused by *C. parasitica* (MURR.) BARR, the cause of chestnut blight, but the fungus on

M. faya was clearly not this species. Identification efforts for the new *Cryphonectria* sp. are currently under way.

The root-rotting fungus *Armillaria mellea* (VAHL:FR.) QUÉL. (BASIDIOMYCETES: TRICHOLOMATACEAE) was found associated with a declining *M. faya* tree on the island of Pico. Although we observed only a single affected tree, there is little reason to doubt that this cosmopolitan fungus may be well distributed throughout the islands, infecting a variety of woody species. Although the observation of *A. mellea* on *M. faya* is of scientific interest, the wide host range of *A. mellea*, which is known to include Hawaiian trees, would minimize the importance of this fungus as a biocontrol agent in the classical sense. Leaf spots caused by *Septoria* sp. ((FUNGI IMPERFECTI: COELOMYCETES) from *M. cerifera* L. and species of *Myrica* from Venezuela (unpublished data) may also attack *M. faya*.

The U. S. National Park Service (U. S. Department of the Interior) has currently in operation a quarantine facility designed to contain foreign insects imported to Hawaii for consideration as biocontrol agents (GARDNER, 1990). This is perhaps the only such facility operated by a non-agricultural agency for biocontrol research. In addition, the Hawaii Department of Agriculture recently completed construction of a quarantine laboratory designed to contain foreign plant pathogens (as distinct from insects) in support of biocontrol research. The high priority given to *M. faya* control by both agricultural and conservation agencies in Hawaii enables use of this laboratory for importation and testing of pathogens, such as those described above, to determine their potential in the biocontrol of this noxious species.

REFERENCES

AZEVEDO, N. F. DOS SANTOS DE:

1960. *Dothiorella* sp. agente de murchidão em *Myrica faya* AIT. Publicações da Direção Geral dos Serviços Florestais e Aquícolas, Vol. XXVII (II): 101-115.

GARDNER, D. E.:

1990. Role of biological control as a management tool in national parks and other natural areas. Report NPS/NRUH/NRTR-90/01, U. S. Department of the Interior, National Park Service, Washington, D. C., 41 pp.

GARDNER, D. E., & C. S. HODGES, JR.:

1990. Diseases of *Myrica faya* (firetree, Myricaceae) in the Azores, Madeira and the Canary Islands. Plant Pathology, 39: 326 - 330.

GARDNER, D. E., & V. A. D. KAGELER:

1982. Herbicidal control of firetree in Hawaii Volcanoes National Park: A new approach. Ecological Services Bulletin, No. 7. U. S. Department of the Interior, National Park Service, Washington, DC., 13 pp.

HODGES, C. S., JR., & D. E. GARDNER:

1985. *Myrica faya*: Potential biological control agents. Technical Report 54. University of Hawaii Cooperative National Park Resources Studies Unit, Honolulu, 37 pp.

KIM, J. Y.:

1969. "Myrica faya" control in Hawaii. Down to Earth 25(3): 23 - 25.

KRAUSS, N. L. H.:

1964. Insects associated with firebush (*Myrica faya* AITON). Proceedings of the Hawaiian Entomological Society, 18(3): 405 - 411.

MARKIN, G. P.:

1991. Insect survey of potential biological control agents of *Myrica faya* in the Azores and Madeira Islands. Technical Report 75. University of Hawaii Cooperative National Park Studies Unit, Honolulu.

MARKIN, G. P. & L. SILVA:

- This volume. The insect Fauna associated with *Myrica faya* in The Atlantic Islands and on mainland Portugal.

SMATHERS, G. A., & D. E. GARDNER:

1979. Stand analysis of an invading firetree (*Myrica faya* AITON) population, Hawaii. *Pacific Science*, 33(3): 239 - 255.

STONE, C. P.:

1985. Alien animals in Hawaii's native ecosystems: Toward controlling the adverse effects of introduced vertebrates. Pp. 251-297 In: C. P. STONE & J. M. SCOTT, eds., *Hawaii's terrestrial ecosystems: Preservation and management*. University of Hawaii Cooperative National Park Studies Unit, Honolulu.

WALTERS, G. A., & W. S. NULL:

1970. Controlling firetree in Hawaii by injection of Tordon 22K. USDA Forest Service Research Note PSW-217. Pacific Southwest Forest and Range Experiment Station, Berkeley, California, 3 pp.

WOODWARD, S. A., P. M. VITOUSEK, K. MATSON, F. HUGHES, K. BENVENUTO, & P. A. MATSON:

1990. Use of the exotic tree *Myrica faya* by native and exotic birds in Hawaii Volcanoes National Park. *Pacific Science*, 44(1): 88-93.