

Fungi Associated with Birdsfoot Trefoil  
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INTRODUCTION

The value of birdsfoot trefoil, *Lotus corniculatus* L., as a forage crop has been recognized for more than 200 years (18). The genus *Lotus* consists of a diverse group of annual and perennial species of wide distribution, yet only *L. corniculatus* is grown extensively in North America having first received recognition in the United States in 1934.

Birdsfoot trefoil has many advantages when compared to other temperate legumes; it is non-bloating, resists heaving, and tolerates a wide range of soil conditions ranging from drought to flooding. The chemical composition and nutrient value of birdsfoot trefoil equals that of alfalfa (*Medicago sativa*). Unfortunately, diseases limit the use and distribution of trefoil. Fungal diseases appear to impose the most important limitations to trefoil adaptation and persistence. Reports dealing with the fungal diseases of birdsfoot trefoil span over 30 years, but a single publication of those diseases and their pathogens has not been compiled. This report will summarize the available literature on the fungal diseases of birdsfoot trefoil that have been associated with root and crown.

Diseases of the Root and Crown

Birdsfoot trefoil behaves as a long-lived perennial in the northern range of its adaptation in North America but appears to be more like a biennial in the southern range. The lack of persistence in the southern range appears to be mainly due to a disease complex commonly referred to as root and crown rot. Stand persistence has been negatively associated with the incidence of crown and root rot disease (11). Losses of 68 to 88% of stands by the end of the 2nd year were reported by Henson (7) who found over 80% of surviving plants badly diseased by root rot. The first symptoms of a root rot infection are more commonly indicated by the failure of plants to resume growth after harvest (2, 7, 12, 14, 16, 18). Ostazeski (14) observed that the appearance of root rot differed in Missouri and Maryland. In Missouri, the roots in advanced stages of disease were typically hollow and often involved the larger lateral roots. In Maryland, the disease was generally confined to the upper tap root and seldom hollow. The decay usually begins in root tissues within an inch of the soil line (16), with the color of the infected tissue varying from tan to reddish brown or black (7, 14).

Rarely can the disease complex be attributed to a single pathogen. Accumulated evidence indicates that a number of environmental and biological factors are involved in the root and crown rot complex. Isolations of organisms from diseased tissues include non-pathogenic and pathogenic fungi, bacteria and nematodes. Nearly all isolates made from infected tissue include pathogenic forms of *Fusarium* (2, 6, 7, 8, 9, 13, 14, 16), but have also included *Rhizoctonia* (6, 7), *Mycocleptodiscus* (10, 13, 14, 15, 16).

*Macrophomina* (7, 13, 16), *Gliocladium* (2, 16), *Phoma* (2), *Rhizopus* 2, *Alternaria* (2), *Papulospora* (2), *Penicillium* (2), *Pyrenochaeta* (2), *Trichoderma* (15), or other miscellaneous genera. However, observers disagree on the role that the known pathogenic fungi have in the development of root and crown rot. Some contend that the pathogenic forms only invade root tissues damaged or killed by other causes (9); others differ on which fungus plays the major role in root and crown rot development.

The disease complex is generally referred to by many as *Fusarium* rot (9) indicative of the omnipresence of this genus. Kainski (8) reported that *Fusarium* species make up the largest number of pathogens causing crown and root rot in birdsfoot trefoil. Major isolates include *F. oxysporum*, *F. solani*, *F. moniliforme*, *F. roseum*, and *F. tricinctum*. Pettis (15) reported finding *Fusarium* sp. to be the pathogen most frequently isolated from the roots of Missouri grown birdsfoot trefoil but also found *Leptodiscus* in substantial numbers; all stands of trefoil 5 to 15 years old had *Fusarium*, but only poor stands had *L. terrestris*. Pettit et al. (16) later hypothesized that *Leptodiscus* exhibits a competitive ability in the presence of other fungi to colonize birdsfoot trefoil roots.

The pathogenicity of *L. terrestris* was described by Gerdemann (5). McVey and Gerdemann (10) determined that birdsfoot trefoil is more susceptible to *L. terrestris* than alfalfa or red clover (*Trifolium pratense*). Ostazeski (13) described *L. terrestris* as one of the most virulent and commonly isolated fungi associated with root and crown rot of birdsfoot trefoil. He proposed the new name *Mycoleptodiscus terrestris* to replace the invalid name of *L. terrestris*.

Pettit et al. (17) reported that the pathogenicity and virulence of several *M. terrestris* isolates from birdsfoot trefoil roots were influenced by other fungal species and further that the disease development of inoculated roots was influenced by temperature and day-length. Henson (7) suggested that the complex of root and crown rotting organisms may vary in pathogenicity from year to year because of differences in environment; *Macrophomina phaseolina* appeared to cause heaviest losses after a drought; *Fusarium* and *Rhizoctonia* appeared to be the primary causes of loss at other times. *Rhizoctonia foliar blight* (*Rhizoctonia solani* Kuehn) can significantly reduce herbage yields (3) and be lethal, but Drake (4) reported death from crown rot by *R. solani* to be more common.

The organisms constituting the crown and root-rot complex appears to also vary with the environment. With the exception of the universally present *Fusarium*, the fungi isolated by Berkenkamp et al. (2) in Alberta Canada were different than those isolated in Missouri (15). As indicated earlier, a number of environmental factors including soil moisture, drainage, air and soil temperature, nutrients, stand density, crop rotation, frequency and height of cutting, insect injury, and previous invasion by viruses and nematodes, have an effect on the expression of the disease complex (1) and plant susceptibility (16). A definite association between *Pratylenchus penetrans*, the root lesion nematode, and *Fusarium* in root rots of birdsfoot trefoil has been reported (19, 20, 21, 22, 23). Willis and Thompson (21) showed that a 75% mortality in birdsfoot trefoil was obtained from a combination treatment of *Fusarium* and *P. penetrans*, when the respective individual treatments resulted in 0 and 10% mortality. Use of a nematicide significantly increased forage yields at first cutting (19) and reduced infections by *Fusarium* equal to a fungicide control 23.

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