HS147

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IFAS EXTENSION

Downy Mildew of Lettuce[1]

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Downy mildew is a serious disease of lettuce that occurs worldwide. Reported in Europe as early as 1843, downy mildew was first reported in the United States in 1875 in Massachusetts. Primarily a foliar disease, lettuce downy mildew has a direct effect on yield and quality, since it affects the marketable portion of the crop. Although yield losses in the field at harvest may be substantial, downy mildew's impact is often accentuated by significant postharvest losses that occur during transit or storage. In Florida, yield losses of up to 100 percent have been reported for individual fields. During the past several years, costs to control downy mildew have risen dramatically.

CAUSAL AGENT AND SYMPTOMS

Lettuce downy mildew is caused by the fungus *Bremia lactucae*. The fungus is an obligate parasite, i.e., it is capable of infecting and colonizing only living host tissue. The fungus belongs to a class of relatively primitive fungi known as the Oomycetes. Other well-known members of this group are *Pythium* and *Phytophthora*.

Bremia lactucae is capable of infecting any lettuce growth stage from seedling to mature plant. Head, leaf, and cos lettuce are all susceptible. Symptoms of downy mildew appear initially as chlorotic yellow spots on the upper leaf surface (Plate 1). Under favorable conditions, a white cottony-like fungal growth that is indicative of sporulation (formation of fungal spores) generally appears on the lower leaf surface within 24 to 48 hours following initial symptom development (Plate 2). During the early stages of disease development, spots are often delineated by the veins of the leaf, giving lesions a rather angular appearance (Plate 3). As the disease progresses, only larger veins obstruct lesion expansion. Lesions become increasingly chlorotic with time and eventually turn brown (Plate 4). Although downy mildew is usually most severe on the older outer leaves, the disease may become systemic over time, infecting lettuce heads internally and colonizing even the roots. Downy mildew lesions may also serve as portals for secondary invaders, such as the fungus *Botrytis cinerea*.

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The term "plates," where used in this document, refers to color photographs that can be displayed on screen from CD-ROM. These photographs are not included in the printed document.

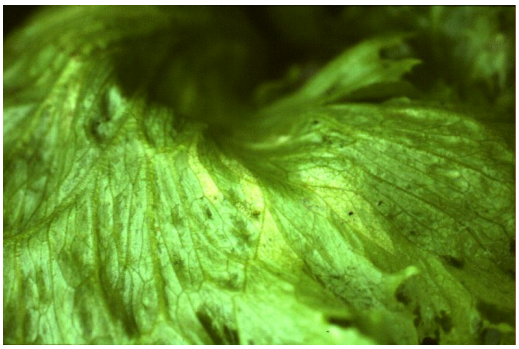

Plate 1.

Plate 2.

Plate 3.

Plate 4.

EPIDEMIOLOGY

Downy mildew is spread by the formation and dissemination of tiny spores called conidia or sporangia. The sporangia are borne on small tree-like structures which emerge through stomates in the leaf surface, resembling oranges on a citrus tree. Clusters of these tree-like structures represent the white cottony-like growth that can be observed without magnification on the lower leaf surface of mildew lesions. Spores are normally formed during the night and are released during the day when the relative humidity is somewhat lower. Sporangia may then be either rain-splashed or wind-disseminated to additional host tissue, each capable of inciting new infections. Although rain-splash dissemination normally ranges from several inches to several feet, sporangia may be windblown tens to hundreds of miles and still maintain their infectivity. Spores of *B. lactucae* may infect, colonize, and produce a second generation of spores in as few as 5 to 7 days. With the potential for tens of thousands of sporangia to be formed on the underside of each lesion under favorable conditions, downy mildew can spread rapidly over large areas. Sporulation and infection by downy mildew are both favored by relatively cool temperatures and humid or moist environmental conditions. For this reason, epidemics in Florida usually occur during the period of December to March, when nighttime temperatures frequently dip into the 40 to 60°F range. Five to 7 hours of high humidity (near 100% RH) or leaf wetness are also required for successful infection and sporulation.

In addition to sporangia, a thick-walled resting spore called an oospore is also formed by *B. lactucae*. However, little is known about its importance in the epidemiology of lettuce downy mildew. There is some evidence to suggest that oospores may allow the pathogen to survive in the absence of a suitable host, thus serving as initial inoculum for next year's epidemic. Others feel that the pathogen's survival on weed hosts in the absence of lettuce is more important as a source of inoculum. Such questions remain to be answered.

CONTROL

Cultivar resistance when available is the most economically feasible form of downy mildew control. At least thirteen single dominant genes for resistance to *B. lactucae* have now been identified. Unfortunately, cultivar resistance to downy mildew has not been durable because of variability within the pathogen population. To be most effective, cultivar selection should be based upon the knowledge of race(s) or strain(s) of downy mildew present in the area. Races are identified based on the pathogen's

ability to infect a standard set of lettuce cultivars known to possess different genes for resistance. Standard commercial crisphead cultivars grown in Florida, `Raleigh' and `Southbay', have both demonstrated susceptibility to the race(s) of downy mildew present during the past several years. However, several butterhead types adapted to Florida conditions, `Everglades', `Mantilla', and `Esmerelda', have demonstrated immunity. In the event of a regional outbreak, susceptible cultivars should be protected with fungicides to avoid major losses.

The list of fungicides currently labelled for lettuce downy mildew control includes maneb, fosetylAl, metalaxyl, and several copper compounds. Resistance in *B. lactucae* to the fungicide metalaxyl was reported in Florida during 1989, and therefore its efficacy may be somewhat reduced. Contact your county agent for current recommendations. With the onset of favorable environmental conditions, fungicide applications should begin at about the 1- or 2-leaf stage and continue throughout the duration of the crop. Applications must be in place prior to infection if adequate control is to be maintained. If downy mildew is known to be present in the area, do not wait until it appears in your own fields to begin your fungicide program.

Several cultural practices, such as the establishment of a lettuce-free period, crop rotation, and the destruction of possible weed hosts, have also been recommended as control measures. Related to sanitation, these measures are targeted at reducing the potential of or at least delaying an initial outbreak. The incorporation of infected crop residues into the soil immediately after harvesting may also help to slow the spread of the disease to other areas. Since moisture or high humidity are required for infection and sporulation, irrigation practices minimizing leaf wetness or soil moisture should also be utilized.

Given the current susceptibility of Florida cultivars, downy mildew is extremely difficult, if not impossible, to maintain at non-economic levels once a major outbreak has occurred. For this reason, prevention and early detection are of the utmost importance. Because of downy mildew's ability to spread over large distances in a short period of time, lettuce producers are urged to communicate freely with each other and with extension personnel and consultants in the area. Early notification that mildew is in the vicinity may be a tremendous help in minimizing control costs and limiting area-wide losses.