**Best Management Practices for Downy Mildew in Cole Crops**

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The 2013 growing season brought many challenges, including downy mildew outbreaks on cole crop seedlings in the spring, and again on mature plants in the fall. In 2012 we saw downy mildew primarily on cabbage, however in 2013 we saw symptoms on cabbage, cauliflower and broccoli. Downy mildew in cole crops is caused by the water mold *Hyaloperonospora brassicae* (formerly known as *Hyaloperonospora parasitica* and *Peronospora parasitica*). The pathogen loves cool wet weather, and actually prefers temperatures between 50 - 59°F. Infection can occur at any stage of growth, but is most common on seedlings in the spring and on mature plants in the fall. Symptoms on seedlings include discolored spots on the cotyledons, which may turn yellow and die. Severe seedling infections can cause plant death. A systemic infection may occur and the pathogen can survive in the vascular system of the plant. Downy mildew is commonly seen in NY in mature plants in September – November. Symptoms start as yellow areas on the upper leaf surface with white pathogen growth on the underside of the leaf (Figures 1 and 2). As the disease progresses, the affected areas enlarge and turn tan and papery. Cabbage, cauliflower and broccoli heads can all develop irregular spotting that can make the crop unmarketable (Figure 3). The pathogen can overwinter in the soil and on crop debris.

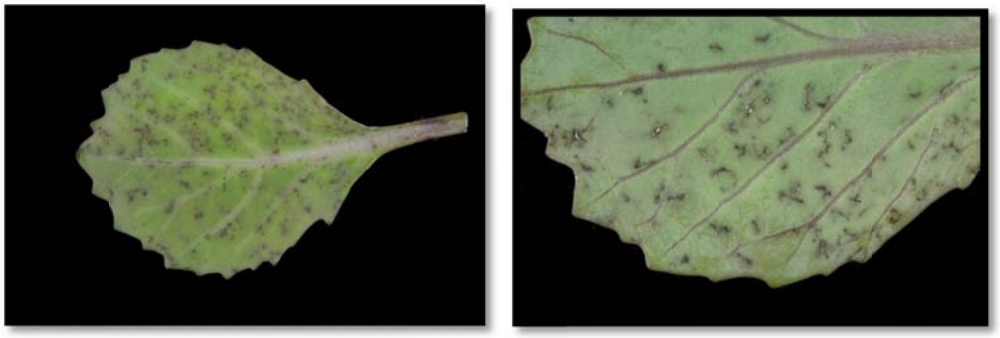

Figure 1. Upper (left) and lower (right) leaf surface of a cabbage seedling with downy mildew.

Figure 2. Images of mature cabbage leaves with downy mildew.

The cole crop downy mildew pathogen, *H. brassicae,* produces wind-blown spores generally found on the lower leaf surface. These spores spread from plant to plant. Cool and wet conditions are necessary for spore production, germination and infection. The pathogen can also

produce overwintering oospores that can survive in soil or crop debris. With the cool wet weather that frequently occurs in the fall in NY, it is difficult to control downy mildew. Resistant varieties (at least in cabbage) are a great option if downy mildew has been a problem on your farm. We have performed several fungicide trials, and have found several active ingredients to be effective including; chlorothalonil, mancozeb, fluopicolide, and copper (although not as effective as the others). In our trials plant defense-inducing products such as acibenzolar-S-methyl were not effective in downy mildew control. In 2013 we ran a fungicide trial to compare efficacy of copper, chlorothalonil, fluopicolide (Presidio) and pyraclostrobin (Cabrio). Because the cabbage downy pathogen is an obligate parasite (can only grow on the plant host, not in culture) we were relying on natural inoculum to move into our trial. Unfortunately downy mildew was never observed in our trial, although there were several commercial cole crop fields in the area that were diseased. We plan to run the trial again in 2014.

Figure 3. Mild (left) and severe (right) symptoms of downy mildew on cabbage. The severe symptoms are caused by secondary rotting pathogens moving into the downy mildew lesions. The picture on the left was taken by Chuck Bornt.