

Updating Foliar Diseases of Beets and Carrots and Their Management

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Foliar diseases of table beets and carrots occur annually and can cause significant yield losses, if they are not monitored closely and managed effectively. Under favorable weather conditions, these diseases can significantly impact the quantity and quality of marketable root yield of beets and carrots and can also interfere with harvesting the roots due to the weakened or dead foliage, that is needed for pulling the roots.

Leaf spot caused primarily by *Cercospora beticola* and to a much less frequency by *Phoma betae* is the major and most prevalent foliar disease impacting beet production in New York. Three important leaf blight diseases occur and damage carrots grown in New York. Two of these diseases are caused by the fungal pathogens *Cercospora carotae* and *Alternaria dauci*, whereas the third is caused by the bacterial pathogen *Xanthomonas campestris* pv. *carotae*. In 2012, a severe incidence of powdery mildew caused by *Erysiphe heraclei* was observed on carrots in several fields throughout the carrot producing regions in New York, probably the result of the dry and hot weather conditions that prevailed throughout the growing season. Interestingly, powdery mildew on carrots was observed for the first time causing significant damage in commercial fields in 2005 under similar weather conditions. Powdery mildew of beets caused by *Erysiphe polygoni* (*E. betae*) was also observed in 2005, but surprisingly it was not observed in 2012. Finally, pocket rot of beets is caused by a special strain of the soilborne fungal pathogen *Rhizoctonia solani* (AG 2-2) and its sexual state (*Thanatephorus cucumeris*) also has a foliar disease phase by initially causing black cankers on the lower petioles and crown tissues of beets. Leaf spot of beets and foliar blights of carrots and their management are summarized below and all foliar diseases will be illustrated and discussed in detail during the presentation.

Leaf spot of beets: Diagnostic symptoms caused by *Cercospora beticola* are the small circular lesions with distinct purple borders and straw color centers (Fig. 1 A). Lesions may become numerous, coalesce and result in pre-mature defoliation of leaves. Prolonged wet conditions favor the development of this disease. *Phoma*-leaf spot has been observed only occasionally in recent years on beets in New York. The lesions of this disease are larger, of various sizes and shapes and with circular rings consisting of the fruiting bodies of the pathogen (Fig. 1 B). The pathogen survives primarily in infected beet tissues in soil and for a rather short time, as compared to the survival of other pathogens. Thus, rotating beets fields for > 2 years will drastically reduce pathogen populations surviving in soil and will contribute to reduced incidence and severity of leaf spots. In addition, the use of high quality seedballs that are treated with effective fungicides have also contributed to reduced disease incidence and severity. However in recent years, leaf spot has been observed occurring on beets earlier in the growing season and at much higher severity. Thus, several field trials were conducted to evaluate the efficacy of selected fungicides in controlling the disease and also to assess the proper timing of the first needed application. For several years, it was observed that the same fungicide sprays applied to control pocket rot (primarily the use of Quadris) were also effective in controlling leaf spot, although there are other effective fungicides. Results of field trials suggested that a threshold of approximately 5 – 10 lesions/10 leaves is the appropriate trigger for the first fungicide spray in order to effectively manage leaf spot.

In 2012, leaf spot incidence and severity were very high in an 80 acre beet field in western New York, as 100% of the plants were infected and there was an average of 28.3 lesions/leaf on August 24. Surprisingly, the beets in this field were already sprayed 3 times with Quadris. An isolate of *Cercospora beticola* recovered from infected plants in this field was confirmed in laboratory tests to be highly resistant to Quadris (azoxystrobin), as it grew even in potato-dextrose agar medium amended with 100-ppm a.i. of Quadris. Three additional isolates of *C. beticola* obtained from other beet fields showed a much lower level of resistance to Quadris in the same laboratory tests. However, all four isolates were found to be highly sensitive to Tilt (propiconazole) in similar laboratory tests. Thus, there is a great need to implement an effective fungicide resistance management program against the leaf spot pathogen by alternating or using a mixture of fungicides with different modes of action and other IPM strategies. The latter will be discussed and illustrated in more detail during the presentation. The development of resistance to several fungicides, including the strobilurins in *Cercospora beticola* on sugar beet is well documented (1, 2). Also, Kirk and his colleagues (3) reported in 2012 the first occurrence of resistance to strobilurin in isolates of *C. beticola* obtained from sugar beets in Michigan and Nebraska.

Foliar blights of Carrots: Lesions of *Cercospora carotae* occur primarily on young leaves, are circular in shape and tan to gray with dark margins (Fig. 2 A). In contrast, lesions caused by *Alternaria dauci* are irregular in shape, brown to black and occur primarily on the margins of older leaves (Fig. 2 B). In contrast, lesions incited by *Xanthomonas campestris* pv. *carotae* appear initially as small yellow spots, but enlarge rapidly into irregular, water-soaked, and brown lesions with a yellow halo (Fig. 2 C). The bacterial lesions are also found mainly on leaf margins and the junctions of leaflet lobes. Unfortunately, symptoms of bacterial infection can be confused with those of *Alternaria* and especially at advance stages of infections. Under favorable temperature and extended periods of leaf wetness, lesions incited by the 3 pathogens become numerous, expand greatly, coalesce and exhibit typical foliar blight symptoms. Symptoms and signs of infection by the 3 pathogens might also progress into the petioles at later stages of disease development. All 3 pathogens are known to be seedborne, thus can be effectively spread in infected or contaminated seeds. Thus, using pathogen-free and/or appropriately treated seeds is critical in the management of these pathogens. Also, these pathogens are able to survive in soil on infected crop residue (Carrots and other species of *Daucus* such as Queen-Anne's lace). Accordingly, rotating fields out of carrots for a minimum of two years, especially with grain crops, is effective in reducing the damage of foliar blights as well as other diseases of carrots. Also, the use of soil management practices that improve soil quality and health by increasing active organic matter content, improving soil aggregation, reducing soil compaction, increasing water infiltration and others will directly or indirectly reduce pathogen populations and damage from carrot diseases as well as improving carrot yield and quality.

An IPM program for the management of *Alternaria*- and *Cercospora*- leaf blights was developed and validated in New York a few years ago (4). The program was based primarily on the use of disease tolerant cultivars (5), crop rotation, the initiation of fungicide applications when disease incidence reaches the 25% threshold level, and then followed with weekly monitoring for the increase in disease severity, as well as the forecasted rainfall and temperature. Several effective and registered fungicides are available for use on carrots to manage these fungal diseases in New York. The latter include Bravo Weather Stick, Quadris, Quadris Opti, Endure, Rovral, Tilt, Pristine, Gem, Champ F and others.

Currently, only copper-based products are available for the management of bacterial blight, a disease that has become more severe and damaging in recent years. Thus, planting of vigorous,

healthy and treated seeds on well-drained soils and also the practicing of an effective crop rotation are all critical in the management of bacterial blight.

References Cited:

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Figure 1. Symptom of *Cercospora* (Fig. 1A) and *Phoma* (Fig. 1B)

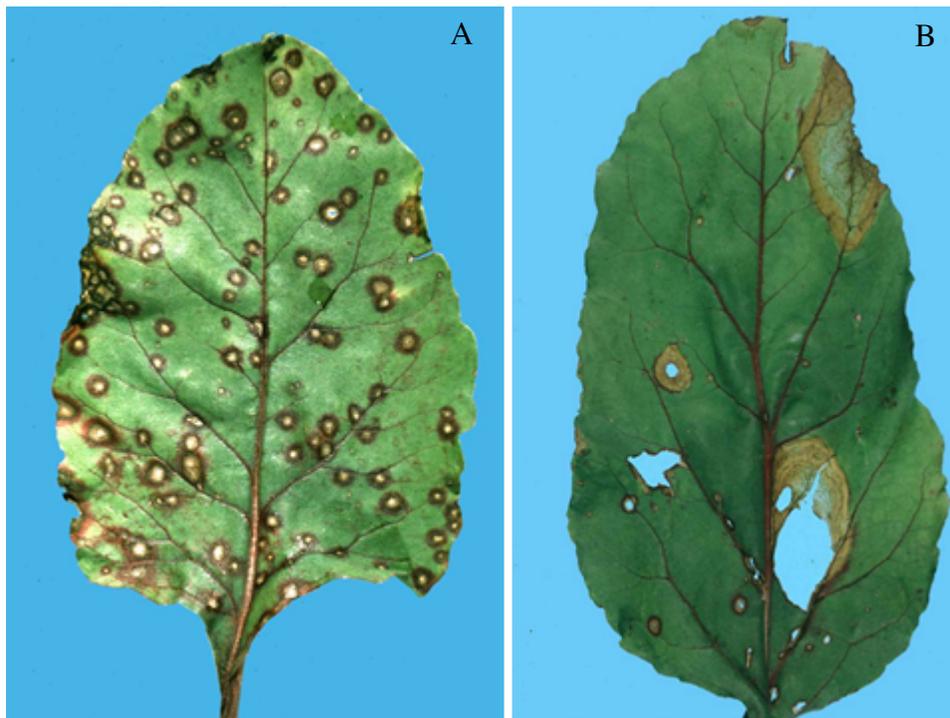


Figure 2. Symptom of Leaf Blight of carrot, *Cercospora* (Fig. 2A), *Alternaria* (Fig. 2B) and Bacterial blight (Fig. 2C)

