

Cercospora leaf spot (*Cercospora beticola*) of Spinach (*Spinacia oleracea*)

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Introduction

Spinach is a highly nutritious vegetable that is rich in vitamins A, C, K, and minerals such as iron and calcium. It is also a good source of antioxidants, which can help protect against diseases. It has been shown to have several health benefits, including reducing the risk of heart disease, improving eye health, and aiding in digestion. Spinach is a versatile vegetable that can be eaten raw or cooked in a variety of dishes. It can be used in salads, smoothies, soups, stews, and pasta dishes, among other things. Spinach is a popular vegetable that is grown and consumed around the world. Its cultivation provides employment opportunities and contributes to the economy. Spinach is a leafy green vegetable that helps in maintaining the soil quality and preventing soil erosion. It also helps in reducing carbon footprint.

Cercospora leaf spot is a fungal disease that affects *Spinacia oleracea*, which is commonly known as spinach. The disease is caused by the fungus *Cercospora beticola*, and it can cause significant damage to the leaves of spinach plants. It can result in significant losses, particularly in late summer when conditions are favorable (high temperatures, high humidity, long leaf wetness periods at night). Leafy greens become unmarketable, and beet roots fail to grow to full size when disease is severe.

Symptomatology

Symptoms occur as numerous, initially small circular leaf spots (see photo). Spots have pale brown to off-white center with a red margin. Lesions expand in size, coalesce, turn gray as the fungus sporulates, and can result in extensive loss of foliage. Younger leaves at the center of the plant are often less severely affected. The pathogen produces sclerotia or

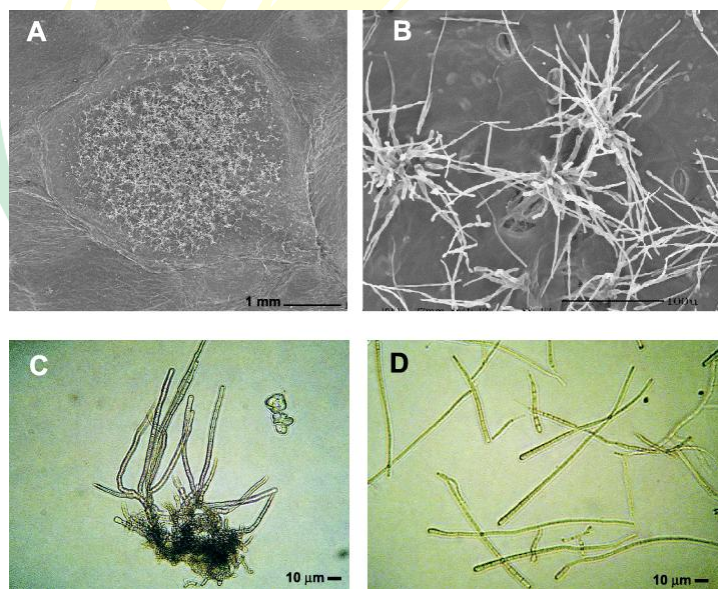
stromata which can be seen with a hand lens as small, black dots in the center of lesions. Lesions may also occur on petioles, flower bracts, seed pods, and seeds.



Symptom of Cercospora leaf spot of Spinach

Life cycle of *C. beticola*

The life cycle of *C. beticola*, the fungus responsible for causing Cercospora leaf spot in spinach and other plants, is complex and involves both sexual and asexual reproduction.



SEM image of leaf symptom (A & B), Conidiophores (c), Conidia (D)

The asexual stage of the fungus produces spores called conidia, which are produced on the surface of the infected leaves. These conidia can be spread by wind or rain and can cause new infections on nearby plants. Under favorable environmental conditions, the conidia can germinate and produce new lesions on the leaves of the plant.

The sexual stage of the fungus occurs on infected plant debris, where specialized structures called pseudothecia are produced. Within the pseudothecia, sexual reproduction occurs, and ascospores are produced. These ascospores can survive for several years in plant debris and can infect new plants during the growing season.

The exact timing and duration of the life cycle of *C. beticola* can vary depending on environmental conditions such as temperature, humidity, and rainfall. However, in general, the fungus can produce multiple generations of conidia in a growing season, and sexual reproduction typically occurs on overwintering plant debris. The disease can persist in a field for several years if not managed effectively.

Epidemiology

The epidemiology of *C. beticola*, the fungus responsible for causing Cercospora leaf spot in spinach and other plants, is influenced by several factors, including environmental conditions, host susceptibility, and cultural practices.

Temperature and humidity are critical factors in the development and spread of the disease. The fungus requires warm, moist conditions for infection and disease development. In general, temperatures between 20-30°C (68-86°F) and high humidity or leaf wetness periods of 6-12 hours are favorable for disease development. Susceptibility of the host plant is also an important factor in the epidemiology of the disease.

Spinach cultivars vary in their susceptibility to Cercospora leaf spot, with some varieties being more resistant than others. The disease can be spread by wind or rain, and infected plant debris can serve as a source of inoculum for new infections.

Management practices

Biological Control

- **Bacillus subtilis:** Bacillus subtilis products are typically applied as a foliar spray or soil drench. The recommended rate for foliar sprays is usually 0.5-1 gram of product per liter of water. For soil drenches, the recommended rate is usually 1-2 grams of product per liter of water.
- **Trichoderma species:** Trichoderma products are typically applied as seed treatment or a soil drench. For seed treatments, the recommended rate is usually 1-2 grams of product per kilogram of seed. For soil drenches, the recommended rate is usually 1-2 grams of product per liter of water.

- **Plant extracts:** The dosage of plant extracts can vary depending on the specific extract being used. In general, these extracts are applied as foliar sprays at a rate of 2-3% solution.
- **Compost and organic amendments:** The application rate of compost and other organic amendments can vary depending on the soil type and crop being grown. In general, a rate of 5-10 tons per acre is recommended.
- **Biological fungicides:** The dosage of biological fungicides can vary depending on the specific product being used. It is important to follow the label instructions and recommendations for application rates.

Chemical Control

- **Chlorothalonil:** Chlorothalonil is a broad-spectrum fungicide usually applied as a foliar spray at a rate of 2-3 pounds per acre.
- **Mancozeb:** Mancozeb is a fungicide usually applied as a foliar spray at a rate of 1.5-2 pounds per acre.
- **Azoxystrobin:** Azoxystrobin is a systemic fungicide usually applied as a foliar spray at a rate of 0.9-1.2 fluid ounces per acre.
- **Propiconazole:** Propiconazole is a systemic fungicide usually applied as a foliar spray at a rate of 4-8 fluid ounces per acre.

Resistant varieties

Here are some examples of spinach varieties that have shown resistance to Cercospora leaf spot:



"Tyee" spinach



"Teton" spinach

**"Melody" spinach****"Emu" spinach**

It is important to note that the level of resistance can vary depending on the specific strain of *C. beticola* present in a region. Therefore, it is important to select spinach varieties that are specifically bred for resistance to the local strain of the fungus. In addition, the use of resistant varieties should be combined with other management practices, such as crop rotation, to reduce the risk of disease buildup over time.

References

- Liu, B., Stein, L., Cochran, K., du Toit, L. J., Feng, C., Dhillon, B., & Correll, J. C. (2020). Characterization of leaf spot pathogens from several spinach production areas in the United States. *Plant Disease*, 104(7), 1994-2004.
- Hasan, M. M., Islam, N. B., Naznin, S., Islam, M. M., & Mustarin, K. E. (2016). Management of *Cercospora* leaf spot of Indian spinach (*Basella alba* L.) with BAU bio-fungicide and a plant growth promoting hormone. *Universal Journal of Plant Science*, 4(4), 43-49.
- Ramkumar, M. O., Catharin, S. S., Ramachandran, V., & Sakthikumar, A. (2021). *Cercospora* identification in spinach leaves through resnet-50 based image processing. In *Journal of Physics: Conference Series* (Vol. 1717, No. 1, p. 012046). IOP Publishing.