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# 10. Studies of Alternaria Leaf Spot Disease Management of Turnip

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***Abstract:***

*Alternaria leaf spot, caused by the fungal pathogen Alternaria spp., poses a significant threat to Turnip (Brassica rapa) cultivation worldwide. This study aims to investigate the etiology, epidemiology, and effective management strategies for Alternaria leaf spot in Turnip crops. The research involves the characterization of Alternaria spp. isolates obtained from infected Turnip plants, employing molecular techniques to identify specific strains responsible for the disease. Epidemiological studies are conducted to understand the factors influencing disease spread and severity under various environmental conditions. A key focus of the study is on developing integrated disease management strategies. Cultural practices, such as crop rotation and sanitation, are explored to minimize pathogen survival and reduce disease incidence.*

*Additionally, the efficacy of chemical control measures, including fungicides with proven effectiveness against Alternaria spp.is evaluated. Biological control methods, involving the use of antagonistic microorganisms, are investigated as sustainable alternatives to chemical interventions. The potential of resistant Turnip cultivars is also explored, aiming to identify and develop varieties with enhanced tolerance to Alternaria leaf spot. Furthermore, the study assesses the impact of environmental factors, such as temperature and humidity, on disease development, providing insights into optimizing management strategies based on seasonal variations. The findings of this research contribute to the development of a comprehensive management plan for Alternaria leaf spot in Turnip*

*cultivation, integrating multiple approaches for sustainable disease control. This knowledge is crucial for enhancing turnip yield and ensuring the long-term viability of Turnip production in the face of Alternaria leaf spot challenges.*

***Keywords:***

*Turnip, Symptoms, Alternaria, Management, Integrated.*

## 10.1 Introduction:

The Turnip, scientifically known as *Brassica rapa,* is an herbaceous plant that can grow as an annual or biennial. It belongs to the *Brassicaceae* family and is cultivated for its edible roots and leaves. The plant features upright stems and a crown formed by 8–12 light green, hairy, and thin leaves. Clusters of light-yellow flowers appear at the top of a raceme, often extending beyond the terminal buds. The leaves can measure 30.5–35.5 cm (12–14 in) in length, and the flowering stems can reach heights of 30.5–91.5 cm (12–36 in). The taproot of the plant is a bulbous tuber, nearly spherical, displaying a mix of purple, white, and yellow hues. Typically grown as an annual, Turnips are harvested after a single growing season. Also known as Annual Turnip, this plant has its origins in Europe. The Turnip (*Brassica rapa* L.), cultivated globally, holds a prominent status as the primary root crop within the Brassicaceae family (Vogl and Reiner, 2007; Wahocho, 2016). While larger varieties are specifically grown for animal consumption, smaller, delicate types are cultivated to serve as a nutritional source for humans. Turnips are rich in various essential elements, including iron, calcium, carbohydrates, protein, and vitamins (A, B, and C). Among the challenges faced in *Brassicaceae* farming, foliar diseases stand out as limiting factors. Alternaria, a fungus within the *Brassicaceae* family, notably causes Leaf spot disease (Reis and Boiteux, 2010). Although these pathogens may not necessarily impact the size or weight of the harvested plant, they lead to significant losses due to the compromised quality and appearance of the affected crops. Occasionally, leafy brassicas like bok choy and Chinese cabbage may incur severe damage, compromising their commercial viability (Koike, 2007). Dark leaf spot in Brassica crops, such as Turnips, is attributed to *Alternaria brassicicola*. This disease exerts a substantial global impact and can reduce yields in brassica crops like Rapeseed or Canola by 20 to 50%. *A. brassicicola* affects all parts of the plant, including seeds, seedlings, pods, and leaves, causing dark leaf blotches.

The fungus can spread through both wild and cultivated varieties, and mycelium can be found both internally and externally. Mycelium that survives on crop waste has the potential to act as a disease inoculum (Kohl and Wolf, 2005). Disease prevention in seed crops is crucial for obtaining healthy seeds. Worldwide, research has been conducted on the antifungal properties of plant extracts, as synthetic chemicals are harmful to the environment and human health. Plant scientists are concerned about the environmental impact and seek eco-friendlier and cost-effective resources for preventing plant diseases (Sasode et al., 2012).

Various medicinal plants such as Eucalyptus, Neem, Pudina, and Datura have been used in both raw and boiled forms to combat *Alternaria brassicae*. Studies on Eucalyptus and Neem oils have also been conducted, and all forms (Crude, boil, and Oil) strongly inhibit fungus

growth. Among the studied forms, Neem crude extract exhibited the least pathogen growth on all media, and boiled Neem extract performed the best. Research has shown that Neem crude extract has antifungal properties against *A. brassicae* (Sasode, 2012). This chapter focuses on the management of Alternaria leaf blight in Turnips.

**Figure 10.1: Turnip White Turnip**

## 10.2 Major Disease of Turnip:

### Alternaria Leaf Spot:

Brassicas/Turnip face significant harm from three distinct Alternaria species: *Alternaria brassicicola*, *A. brassicae*, and *A. raphani*. Broccoli, Brussels sprouts, Cabbage, Cauliflower, Chinese cabbage, kohlrabi, Kale, Rutabaga, and Turnip are susceptible to infections from *Alternaria brassicicola* and *A. brassicae*, while *A. raphani* primarily targets Radish but can also affect other *Brassica* crops.

The development of the disease is facilitated by cool temperatures and prolonged periods of leaf wetness or high humidity, making Alternaria leaf spot a potential constraint in regions where such conditions prevail.

In the Northeast, Alternaria infections typically initiate during humid summer weather, persisting into fall when Brassica leaves remain wet due to dew. Infections can lead to a decline in crop quality and yield by causing damage to seedlings, leaves, and heads.

Brussels sprouts, in particular, may become unsuitable for the market due to Alternaria lesions on the buds. The disease can also spread during storage, underscoring the crucial importance of effective management. Regular inspections for early symptoms before storage are advisable to mitigate the spread of Alternaria.

### Symptoms:

Alternaria leaf spot is a common fungal disease that affects a variety of plants, including Turnips. The disease is caused by fungi belonging to the Alternaria genus, with *Alternaria brassicicola* being a specific species that often affects Cruciferous vegetables like Turnips. Here are the detailed symptoms of Alternaria leaf spot in Turnips:

The initial indications of Alternaria leaf spot involve small black dots encircled by chlorotic halos. As the infection advances, the lesions transform into distinct circular leaf spots, ranging from dark brown to black, displaying concentric rings resembling a target. The centers of these lesions often undergo a browning process, leading to cracking or detachment, creating a shot-hole pattern within the leaf spots. These individual spots amalgamate into extensive necrotic areas, potentially causing the shedding of leaves.

Typically, symptoms manifest first on older and lower leaves, progressing upward as the disease spreads. In addition to affecting leaves, lesions can also emerge on petioles, and stems.

**Here are the detailed symptoms of Alternaria leaf spot in Turnips:**

**1. Leaf Lesions:**

**Shape and Color:** The disease typically starts as small, round lesions on the leaves.

**Color Changes:** Lesions appear dark brown to black in the center with a lighter, yellowish margin.

**2. Lesion Growth:**

**Enlargement:** Lesions tend to grow in size over time, coalescing to form larger irregularly shaped spots, displaying concentric rings resembling a target.

**Concentration:** The lesions are often concentrated near the leaf margins or between the veins.

**3. Spore Production:**

**Dark Spores:** As the disease progresses, the center of the lesions may develop a velvety appearance due to the production of dark-colored spores (Conidia) by the fungus.

**4. Leaf Yellowing:**

**Yellow Halo:** Surrounding healthy tissue often shows a yellow halo around the lesions.

**Overall Yellowing:** Severe infections can lead to general yellowing of the affected leaves.

**5. Necrosis and Tissue Death:**

**Cell Death:** The fungus causes necrosis (death of plant cells) in the infected areas.

**Premature Leaf Drop:** Severe infections may lead to premature defoliation, reducing the plant's photosynthetic capacity.

### 6. Stem Lesions:

**Lesions on Stems:** In addition to affecting leaves, Alternaria may also cause lesions on stems, affecting the overall health of the plant. It's essential to note that the severity of symptoms can vary depending on factors such as environmental conditions, the susceptibility of the turnip variety, and cultural practices.

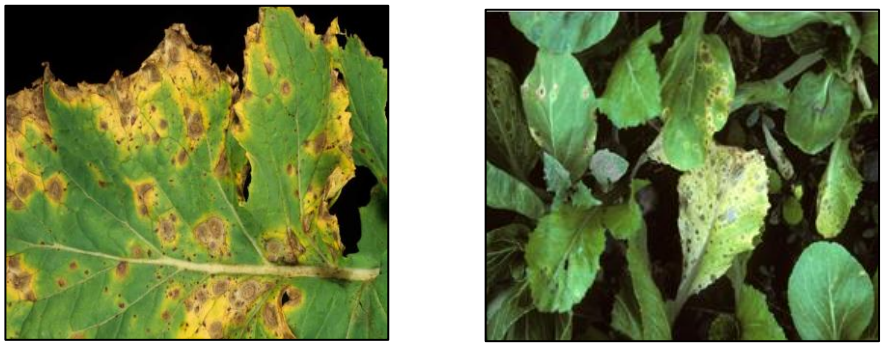

**Figure 10.2: Alternaria leaf spot in Turnips**

## 10.3 Life Cycle:

**Causal organism of Alternaria leaf spot in Turnip**-*Alternaria brassicicola:*

*Alternaria* species, functioning as uncomplicated parasites, persist in a saprophytic stage outside their host. The primary site for their survival from one year to the next is diseased crop remnants.

Resting spores such as Chlamydospores and Microsclerotia have been reported. Optimal conditions for Spore production involve exposure to high humidity levels (around 87%) and temperatures ranging between 68 and 86°F. Spores are released during warm, dry periods following rainfall. The most conducive conditions for initiating new infections occur at temperatures between 55 and 75°F, accompanied by high relative humidity or prolonged leaf wetness periods. Spores generated in the summer heat proliferate as the weather cools during the transition to fall.

The primary wintering grounds for *Alternaria* species are predominantly in diseased crop residue. The pathogen can also endure on seeds, both internally and on their surfaces. Infested seeds serve as the main vehicle for introducing the pathogen into new areas. However, *Alternaria* fungi disperse a substantial quantity of airborne spores, facilitating easy transmission from one field to another and from one farm to another once the disease has taken hold. Apart from wind dissemination, *Alternaria* spores are spread within fields through splashing water, as well as by insects, equipment, and personnel navigating through the fields.

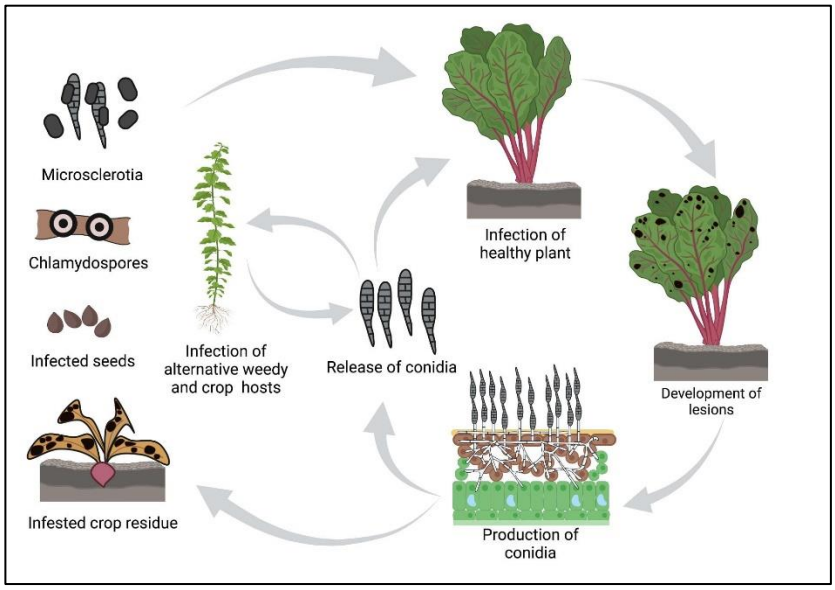


**Figure 10.3: Life Cycle**

## 10.4 Management of Alternaria Leaf Spot in Turnip:

### 10.4.1 Cultural Methods to Control the Alternaria Leaf Spot Disease in Turnip in Detail:

Cultural methods play a crucial role in managing Alternaria leaf spot disease in Turnips. These methods focus on creating conditions that are unfavorable for the growth and spread of the Alternaria pathogen. Here are some cultural practices you can implement:

1. **Crop Rotation:** Rotate Turnip crops with non-host plants to break the disease cycle. Avoid planting turnips or other susceptible crops in the same location year after year. This helps reduce the buildup of Alternaria inoculum in the soil (Sharma, P., & Bhat, R. 2013).
2. **Sanitation:** Remove and destroy infected plant debris promptly to eliminate potential sources of inoculum. Proper disposal of crop residues reduces the overwintering of Alternaria spores, preventing their recurrence in the next growing season. (University of California Statewide Integrated Pest Management Programme 2009).
3. **Adequate Spacing:** Plant Turnip crops with proper spacing to ensure good air circulation. This helps in reducing humidity around the plants. Dense canopies with poor air circulation create favorable conditions for the disease (Agrios, G. N. 2005).
4. **Avoid Overhead Irrigation:** Utilize drip or soaker hose irrigation systems instead of overhead sprinklers. Wet foliage provides an ideal environment for Alternaria spore germination and infection. Keeping the foliage dry can help minimize disease development. (Compendium of Ornamental Foliage Plant Diseases. 1996).
5. **Proper Fertilization:** Maintain balanced and proper fertilization practices. Over-fertilization, especially with nitrogen, can promote lush growth that is more susceptible

to Alternaria infections. Follow recommended fertilizer rates and timings (Brady, N. C., & Weil, R. R. 2008).

6. **Resistant Varieties:** Choose Turnip varieties that are resistant or tolerant to Alternaria leaf spot. Resistant varieties can significantly reduce the impact of the disease, providing an effective long-term strategy (Fitt, B. D. L., Huang, Y. J., van den Bosch, F., & West, J. S. 2006).

Remember to adapt these cultural practices to your specific growing conditions and consult with local agricultural extension services for region-specific recommendations. Integrated pest management (IPM) approaches that combine cultural, biological, and chemical methods may provide the most effective control.

## 10.4.2 Chemical Control of Alternaria Leaf Spot in Turnip:

1. **Chlorothalonil:** Chlorothalonil is a broad-spectrum fungicide effective against Alternaria species. It works by inhibiting fungal cell membrane synthesis (Khan, M. R., & Fischer, G. W. 1972).
2. **Mancozeb:** Mancozeb is a protective fungicide that forms a barrier on the plant surface, preventing fungal spores from germinating (Cohen, Y., Gisi, U., & Niderman, T. 1993).
3. **Azoxystrobin:** Azoxystrobin is a systemic fungicide that inhibits mitochondrial respiration in fungi, controlling Alternaria leaf spot (Knaus, B. J., & Percich, J. A. 2004).
4. **Propiconazole:** Propiconazole is a systemic triazole fungicide that interferes with the synthesis of ergosterol, an essential component of fungal cell membranes (Oliver, R. P. 2014).

## 10.4.3 Biological Control of Alternaria Leaf Spot in Turnips:

### 1. Introduction:

Alternaria leaf spot, caused by various species of the Alternaria genus, is a common fungal disease affecting turnips and other cruciferous vegetables. Biological control methods aim to manage these diseases using living organisms to suppress or limit the growth of pathogens.

### 2. Antagonistic Microorganisms:

***Trichoderma spp.:*** Certain species of Trichoderma fungi are known for their antagonistic activity against Alternaria. They can compete for nutrients and space, as well as produce secondary metabolites that inhibit the growth of Alternaria pathogens.

***Bacillus spp.*:** Some Bacillus species, such as *Bacillus subtilis,* produce antifungal compounds that can inhibit the growth of Alternaria. They also enhance the plant's defense mechanisms.

**3. Use of Beneficial Fungi:**

**Mycorrhizal Fungi:** These fungi form symbiotic relationships with plant roots, enhancing nutrient uptake and promoting plant growth. In turn, a healthier plant may be more resistant to fungal diseases like Alternaria leaf spot.

***Beauveria bassiana:*** This entomopathogenic fungus has been explored for its potential to control not only insect pests but also certain plant pathogens, including Alternaria.

**4. Inducing Plant Resistance:**

**Plant Growth-Promoting Rhizobacteria (PGPR):** Certain rhizobacteria can induce systemic resistance in plants, making them more resilient to pathogenic attacks. This includes resistance against Alternaria species.

**5. Biological Control Agents (BCAs):**

**Commercially Available BCAs:** Some companies produce and market biological control agents specific to Alternaria control. These formulations often contain beneficial microorganisms or compounds that suppress the growth of Alternaria.

## 10.5 Conclusion:

Research on the control of Alternaria leaf spot disease in *Brassica rapa*, or turnip, has identified a number of useful tactics. For the best control, integrated disease management strategies that combine chemical, biological, and cultural treatments are crucial. Cultural techniques that increase air circulation, such as crop rotation, debris removal from plants, and appropriate spacing, can dramatically lower the incidence of disease. Using resistant cultivars is another important tactic that offers a sustainable and eco-friendly answer. The use of beneficial bacteria such as Trichoderma spp. and Bacillus spp. in biological management techniques has demonstrated potential in controlling Alternaria infections. By a variety of strategies, these biocontrol agents are able to directly oppose the infections or outcompete them for resources. Furthermore, using bio-fungicides made from natural sources is a more environmentally responsible option than using synthetic chemicals. Chemical control is still essential, particularly in cases of severe epidemics. Fungicides that have been proven to be effective against Alternaria species include difenoconazole, mancozeb, and chlorothalonil. However, an over reliance on chemical fungicides may result in environmental issues and the emergence of resistance. As such, its application ought to be prudent and coordinated with other management techniques.

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