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Onion Purple Blotch

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Purple blotch, caused primarily by the fungal pathogen *Alternaria porri* (Ellis) Ciferri, stands as a critical constraint to global onion (*Allium cepa* L.) production. This disease complex, sometimes involving *Alternaria allii* Nolla or a synergistic association with *Stemphylium vesicarium*, leads to substantial yield losses, potentially ranging from 30% to 100% under favorable environmental conditions. This review synthesizes current knowledge regarding the pathogen's etiology, its physiological requirements, and the necessity for an integrated disease management (IDM) approach, emphasizing both conventional and molecular breeding strategies for sustainable control.

Introduction

- Onion (*Allium cepa* L.) is one of the most economically important vegetable crops.
- It is highly valued for its culinary, nutritional, and therapeutic uses.
- Onion productivity is severely threatened by various diseases.
- Purple blotch is considered the most destructive foliar disease of onion.
- It can cause devastating crop losses in both bulb and seed production.
- The disease is especially severe in warm and humid environments

Etiology and Epidemiology of the Pathogen

1.Causal Agents and Taxonomy

- The principal causal agent of the disease is the deuteromycetous fungus *Alternaria porri*.
- Taxonomic classification:
  - ✓ Kingdom: Fungi
  - ✓ Division: Ascomycota
  - ✓ Class: Dothideomycetes
  - ✓ Order: Pleosporales
  - ✓ Family: Pleosporaceae
  - ✓ Genus: *Alternaria*
- The fungus Stemphylium vesicarium may initiate infection.
- Its presence can facilitate the infection process by *A. porri*.
- This interaction helps lead to the development of typical purple blotch symptoms.
- Symptoms appear on leaves, flower stalks, and bulbs.
- Initial symptoms:
  - ✓ Small, water-soaked lesions
  - ✓ Whitish or orange in color
- As the disease progresses:
  - ✓ Lesions become elliptical and sunken
  - ✓ Turn purplish-brown
  - ✓ Show distinct concentric rings
  - ✓ Surrounded by a yellow halo

- Advanced infection results in:
- ✓ Girdling and collapse of foliage
- ✓ Reduced photosynthetic activity
- ✓ Significant reduction in bulb and seed yield

2. Pathogen Physiology

- Mycelium: Branched, septate, and colored.
- Conidiophores: Arise singly or in groups, are straight or slightly curved, and are pale brown.
- Conidia: The conidia are multicelled, muriform, and obclavate (club-shaped), Produced in chains, are 100-300 µm long and 15-20 µm thick, and have a dark brown or purplish color.
- Colony: On culture media, colonies are initially white and turn purple .

3. Mode of Spread

1. Primary inoculum sources**:**
- Conidia and mycelia in infected plant debris, weeds, and alternate hosts.

2. **Secondary spread occurs through:**
- ✓ Wind
- ✓ Rain splashes
- ✓ Entry through wounds on plant tissue.

Disease Management Strategies

Cultural and Chemical Control

- Integrated Disease Management (IDM) relies on cultural practices to reduce inoculum and disease-favorable conditions.
- Sanitation:
- ✓ Remove and destroy infected plant debris.
- Crop Rotation:
- ✓ Rotate with non-Allium crops to break the disease cycle.
- Drainage and Spacing:
- ✓ Maintain well-drained soil.
- ✓ Increase plant spacing to reduce canopy humidity.
- Chemical control:
- ✓ Remains a key protective measure but increases costs and may cause environmental concerns.
- ✓ Effective fungicides include: Treat the seed with thiram (2.5 g/kg), and protect the crop with three sprays of copper oxychloride, chlorothalonil, or mancozeb/zineb at the recommended doses(0.2%).

Biological Control and Botanical

- Biological agents and botanicals provide environmentally friendly IDM options.

- Seed and Foliar Treatments:
  - ✓ Seed treatment with Trichoderma harzianum or Pseudomonas fluorescens enhances germination and reduces disease incidence.
  - ✓ Foliar sprays of these bio-agents or neem-based products (e.g., Neembicidine) are effective under field conditions.
- Botanicals:
- Plant extracts such as:
  - ✓ *Allium sativum* (garlic clove extract)
  - ✓ Aloe vera extract
  - ✓ Neem oil
  - ✓ Pongamia oil
- These have shown in vitro inhibitory effects against *A. porri*.

Host Resistance

- Most sustainable strategy:
  - ✓ Developing and deploying disease-resistant varieties is the most effective long-term approach.
- Sources of Resistance:
- Identified resistant lines/varieties include:
  - ✓ Arka Kalyan
  - ✓ VL Paiz-1
  - ✓ PBR-287
  - ✓ CBT-Ac77 (accession)
- Hybrids such as Red Creole × Kaharda have also shown resistance.

Genetic Basis

- Resistance to *A. porri* is governed by a single dominant gene, named ApR1.

Molecular Tools

1. The ApR1 gene has been genetically mapped.
2. It is linked to molecular markers including:
   - SSR markers (e.g., AcSSR7)
   - STS markers (e.g., ApR-450)
3. These markers are valuable for Marker-Assisted Selection (MAS), enabling precise and efficient selection of resistant genotypes in breeding programs.

Conclusion

Purple blotch disease remains a significant phytopathological challenge due to the pathogen's high reproductive capacity and the prevalence of conducive environmental factors. While chemical and biological controls provide immediate relief, the long-term solution lies in durable host resistance. Future research should prioritize fine mapping of the ApR1 locus using high resolution DNA markers, such as Single Nucleotide Polymorphisms (SNPs). This will facilitate the validation and deployment of flanking markers, accelerating the introgression of the ApR1 gene into diverse genetic backgrounds and achieving stable resistance for global onion cultivation.

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