College of Food, Agricultural, and Environmental Sciences, Department of Plant Pathology

Neopestalotiopsis Disease of Strawberry

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Neopestalotiopsis disease, commonly referred to as "Neo-P" is an emerging fungal disease affecting cultivated strawberry (*Fragaria × ananassa*) that has gained increasing attention due to its rapid spread and impact on plant health and productivity. When conditions are conducive, severe outbreaks can result in yield losses exceeding 50% in susceptible varieties. The disease can occur in both field-grown and greenhouse-produced strawberries. Its increasing occurrence in the Midwestern United States has raised concern among growers and propagators due to its aggressiveness, rapid disease development, and the lack of fungicides specifically registered for its control. The disease is caused by species within the genus *Neopestalotiopsis*, which are capable of infecting multiple parts of the strawberry plant, including leaves, petioles, crowns, roots, and occasionally fruit. Infected plants may develop a complex of symptoms including leaf blight, crown rot, root rot, and, in severe cases, plant collapse (Figure 1–3).

Disease Development and Symptoms

Neopestalotiopsis disease development is strongly influenced by environmental conditions that favor pathogen survival, dispersal, and infection. Optimal temperatures for disease development typically range from 68 degrees Fahrenheit to 86 F (20 degrees Celsius–30 C), although symptoms may occur at lower temperatures. High relative humidity (greater than 80%) and prolonged periods of leaf wetness are critical for spore germination and infection. Free moisture, particularly from rainfall or overhead irrigation, facilitates dispersal of the pathogen through water splash. Dense plant canopies and poor air circulation further enhance disease development by maintaining humid microclimates conducive to infection. Under favorable conditions, the pathogen produces spores (conidia) on infected tissues.



Figure 1. Neopestalotiopsis disease in strawberry production systems. (A) Infected nursery plants (plug plants) showing severe foliar blight symptoms (dotted red line). (B) Wilted and dead plants (red arrows) in a fruit production system with plastic mulch, illustrating disease impact under field conditions. Photos by Antonio Alcala Madrigal.

These spores are dispersed primarily by water splash and can infect susceptible plant tissues through natural openings, wounds, or direct penetration. Repeated cycles of infection may occur throughout the growing season, leading to rapid disease spread when environmental conditions remain favorable.

The pathogen is introduced into production systems through infected nursery plants, which serve as a primary source of inoculum. In some cases, the pathogen may be present in plants that appear healthy, or asymptomatic, allowing it to be introduced unnoticed into production fields or greenhouses. Once established, the pathogen can persist in plant debris and infected tissues, including leaves, crowns, and roots. It can survive in these materials as mycelium or within specialized fungal structures called acervuli during the winter months, allowing it to survive for several months and providing an additional source of primary inoculum for subsequent plantings.



Figure 2. Foliar symptoms of Neopestalotiopsis disease on strawberry. (A) Necrotic leaf spots and blight on strawberry cv. Rociera. (B) Close-up of leaf lesions and fungal fruiting bodies (acervuli) on cv. Valiant. Photos by Antonio Alcala Madrigal.

Symptoms vary depending on the infected tissue and stage of disease development. On leaves, initial symptoms appear as small, dark-brown lesions that expand and coalesce, resulting in extensive leaf blight. Lesions may be surrounded by reddish or chlorotic halos. Petioles may develop elongated, sunken lesions that can progress toward the crown, leading to wilting and plant decline. In advanced stages, infections of the crown and root system result in dark necrotic



Figure 3. Crown and root rot symptoms associated with Neopestalotiopsis disease in proprietary strawberry cultivars. (A) Differences in root susceptibility between two cultivars, with one showing localized symptoms and the other showing extensive root necrosis. (B) Necrosis of crowns and roots. (C) Close-up of brown necrotic lesions within crown tissue. Photos by Antonio Alcala Madrigal.

tissues, impairing water and nutrient uptake, and ultimately causing plant collapse (Figure 4). In some cases, fruit may also be affected, developing sunken lesions that reduce marketability. However, fruit symptoms are uncommon in the Midwestern United States.

In addition to symptoms, *Neopestalotiopsis* sp. may produce visible signs on infected tissues. Small, black, dot-like fungal structures (acervuli) may develop on leaf and fruit lesions (Figure 5). These structures are embedded in plant tissue and can often be observed with the naked eye or with the aid of a hand lens. Acervuli produce conidia that contribute to secondary spread of the pathogen.

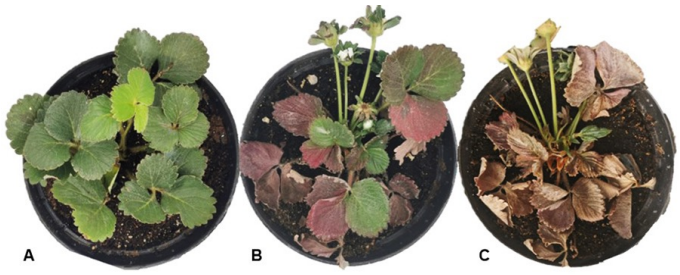

Figure 4. Progression of crown and root rot caused by Neopestalotiopsis sp. in strawberry cv. Camino Real plants. (A) Healthy plant. (B) Advanced foliar symptoms associated with crown and root rot, including leaf discoloration and plant decline. (C) Severe disease with wilting and plant collapse. Photos by Antonio Alcala Madrigal.

Management

Effective management of Neopestalotiopsis disease requires an integrated approach that focuses on preventing pathogen introduction, reducing inoculum sources, and minimizing environmental conditions favorable for infection and spread. Because the disease is strongly associated with infected planting material and rapid secondary spread, proactive management is essential.

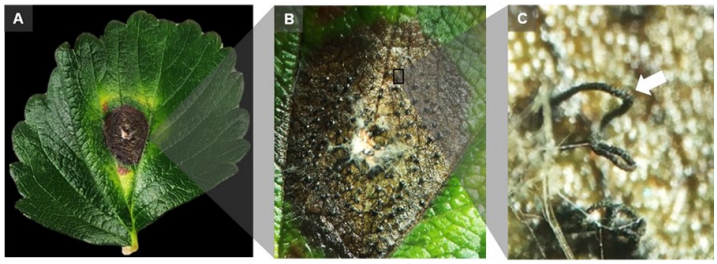

Figure 5. Symptoms of Neopestalotiopsis sp. on strawberry leaves (cv. Chandler). (A) Early leaf spot with a dark center and yellow halo. (B) Advanced lesion with black fungal fruiting bodies (acervuli) visible on the surface. (C) Close-up of spore masses (cirrhi) exuding from the lesion under humid conditions. Photos by Antonio Alcala Madrigal.

Early Detection and Testing

Because symptoms of *Neopestalotiopsis* disease may resemble other strawberry diseases, accurate diagnosis is important for management decisions. Laboratory confirmation through microscopic examination and molecular identification may be necessary, particularly when symptoms are associated with crown rot or plant collapse. Growers are encouraged to contact local extension personnel or plant disease diagnostic clinics for assistance, such as The Ohio State Unviersity Plant and Pest Diagnostic Clinic (PPDC) strawberry submission website (ppdc.osu.edu/submit-sample/fruits/strawberries).

Clean Plants

The use of clean planting material is critical for preventing the introduction of *Neopestalotiopsis* spp. into production systems. Infected nursery plants represent the primary source of inoculum in many outbreaks, and the pathogen may occasionally be present in plants that appear asymptomatic. Growers are encouraged to select reputable nursery sources and avoid planting material with visible symptoms.

Pre-transplant chemical treatments may help reduce the risk of introducing the pathogen into

production and should be considered as part of a preventive management program.

Variety Selection

At present, no strawberry varieties are known to be resistant to *Neopestalotiopsis* disease. However, observed differences in susceptibility suggest that variety selection may influence disease incidence and severity. Preliminary studies conducted in Ohio indicate that Albion and Chandler cultivars are highly susceptible, while Douglas and Sweet Charlie are also susceptible. Other varieties, including D'Light, AC Valley Sunset, Cabot, Flavorfest, Allstar, Galleta, Northeaster, and Jewel, developed some level of disease. In contrast, Earliglow, Honeoye, Mira, Seneca, and Scarlet did not develop symptoms. Disease development can be facilitated by plant injury and vary among isolates of the pathogen. Continued research is needed to identify resistant or tolerant varieties that could be incorporated into disease-management programs. In the meantime, growers are encouraged to prioritize early detection and best cultural practices to minimize disease impact.

Cultural Practices

Cultural practices play a key role in reducing disease development by minimizing the impact of environmental conditions favorable for infection. Practices that reduce the duration of leaf wetness, such as improving air circulation through appropriate plant spacing and avoiding overhead irrigation when possible, are recommended. Greenhouse environments should be managed to minimize prolonged periods of moisture on plant surfaces. Handling plants when wet should be avoided to reduce mechanical spread of the pathogen.

Removal and destruction of infected plant material can help reduce inoculum levels within the field and greenhouse. In the field, using mulch between rows can also help reduce splash dispersal of the pathogen. In fields with a history of Neopestalotiopsis disease, rotating away from strawberry production may help reduce inoculum levels, although the optimal rotation period has not been clearly defined. Recent research in Ohio indicates that the pathogen can survive in silt loam soils through the winter months (December–April). Therefore, avoiding repeat-planting in infested soils is recommended to reduce disease pressure over time.

Chemical and Biological Control

Currently, no fungicides are specifically registered for the control of *Neopestalotiopsis* disease in strawberry. However, studies from other production regions indicate that some fungicides used in standard strawberry disease management programs, including Switch 62.5WG (cyprodinil + fludioxonil), Tilt (propiconazole), Rhyme (flutriafol), and Thiram (thiram), may provide activity against *Neopestalotiopsis* under certain

Box 1. What is FRAC?

The Fungicide Resistance Committee (FRAC) is an international organization that classifies fungicides based on their mode of action. Fungicides are assigned letters to identify their specific mode of action:

- Multisite fungicides begin with the letter M.
- Fungicides with an unknown mode of action begin with the letter U.
- Biologicals with multiple modes of action are assigned BM.
- Plant-host defense inducers are assigned P.

The FRAC codes are located at the top of the first page of a fungicide label, and the label also includes a section on resistance management.

Detailed information on FRAC codes, including cross-resistance patterns and modes of action, are available at FRAC Fungicide Resistance Action Committee (frac.info).

conditions. These products should be used only as part of an integrated disease management program and rotated according to Fungicide Resistance Action Committee (FRAC) codes (Box 1) to reduce the risk of fungicide resistance. This ensures that fungicides with different modes of action are alternated and not applied consecutively. Always follow product labels and current regional recommendations.

Commercial growers should consult the *Midwest Fruit Pest Management Guide* (ag.purdue.edu/department/hla/extension/sfg-sprayguide.html) and local extension recommendations for the most current fungicide recommendations, including those used as pre-plant treatments.

Biological control agents, including species of *Trichoderma* and *Bacillus*, have shown potential for suppressing the pathogen under experimental conditions through mechanisms such as competition and antibiosis. However, their effectiveness under field/greenhouse conditions is still under evaluation, and they should be considered complementary tools rather than standalone solutions.

Additional Resources

- Fruit Pathology, Ohio State University Extension (u.osu.edu/fruitpathology)
- Neopestalotiopsis disease in strawberry:what do we know? (smallfruits.org/2021/10/neopestalotiopsis-disease-in-strawberry-what-do-we-know)

QR code for The Ohio State University Plant and Pest Diagnostic Clinic strawberry submission web page

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