



AGRI MAGAZINE

(International E-Magazine for Agricultural Articles)

Volume: 03, Issue: 06 (June, 2026)

Available online at <http://www.agrimagazine.in>

© Agri Magazine, ISSN: 3048-8656

Spot Blotch Disease of Wheat: An Emerging Threat to Wheat Production

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Wheat is a nutrient-dense staple crop, a number of detrimental factors affect its production. The most well-known biotic factor affecting wheat is spot blotch, which is caused by *Bipolaris sorokiniana* (teleomorph *Cochliobolus sativus*). The Eastern Gangetic Plains (EGP) in South Asia is a hotspot for the disease, which primarily affects warm, humid wheat-growing regions. In the North Eastern Plains Zone (NEPZ), which represents a warm and humid climate in India and other South Asian nations, it is the most significant wheat disease. Due to global climate change, wheat spot blotch, which was formerly considered a minor disease, is becoming much more common. Due to climate change, it is also growing in the North Western Plains Zone (NWPZ) and causing losses in vulnerable kinds. Small, dark brown lesions that are 1 to 2 mm long and have no chlorotic edge are the hallmark of early symptoms. These lesions, which range in color from light brown to dark brown, spread swiftly in oval to elongated spots in susceptible genotypes. Before they unite and cause the leaf to die, they may grow up to several centimeters. According to reports, yield losses from spot blotch can range from 15.5 to 19.6%, and in cases of severe illness, they can reach 100%. Relative humidity of about 95%, an average temperature in the coolest month over 17 °C, and extended periods of leaf wetness (more than 12 to 18 hours) brought on by rainfall, irrigation, fog, or dew are ideal for spot blotch development on the leaves. Although there are several approaches to manage spot blotch disease, coordinated management is the most effective. It involves the application of foliar fungicides, biological control, crop rotation, cultural management, seed treatment and disease-resistant cultivars.

The Pathogen

Spot blotch is caused by *Bipolaris sorokiniana* (Sacc.) Shoem. Syn. *Drechslera sorokiniana* (Sacc.) [Syn. *Helminthosporium sativum*, teleomorph *Cochliobolus sativus*] Subram., and Jain, *Cochliobolus sativus*, *Drechslera* ex Dastur [anamorph *Bipolaris sorokiniana* (Sacc.) Shoem.] and several synonyms of the anamorph have been used like *Helminthosporium sorokinianum*, *Drechslera sorokiniana* and *Helminthosporium sativum*. The pathogen causing spot blotch is the same fungus that causes common root rot. *Bipolaris sorokiniana* is characterized by thick-walled, elliptical conidia (60-120µm × 12-20µm) with 5-9 cells. In axenic culture, the mycelium is composed of hyphae interwoven as a loose cottony mass and appears as white or light to dark grey depending on the isolates. These fungi are differentiated from the *Bipolaris* genus on the basis of morphological features of conidiophores and conidia.

Symptoms

On the coleoptiles, leaves, crowns, stems, and roots, there are dark brown, boat-shaped necrotic areas that may or may not have a yellow halo surrounding them. One typical

indication is darkening of the sub crown internode. On the leaves, lesions begin as a few millimeters and grow into long, dark brown patches larger than one to two centimeters. Sometimes a yellowing that extends beyond the lesion is seen as a result of toxin generation. Later on, these spots combine to form blight on a big section of the leaf. As the disease worsens, the spots come together to form big blotches that finally kill the leaves. Conidia grow easily on leaves in humid environments, spreading over a few centimeters before aggregating and causing the leaf tissue to die. In humid settings, ancient lesions can produce a lot of conidia, and the release of toxins can occasionally cause a chlorotic streak to diffuse from the lesion's edge. Heavily infected plants may show signs of stunting and decreased tillering, which could result in early mortality and white heads. Roots turn rotten and dark brown, and kernels shrivele. Even if the symptoms are not severe, root rot can lower yields.

Epidemiology

The severity of the disease is directly influenced by a number of factors, including tillage selection, irrigation schedule, soil fertility, sowing density, crop growth stage, late rains during the crop cycle, high temperature, and high relative humidity that causes more than 12 hours of leaf wetness. Spot blotch is a disease that spreads through seeds and has soil-dwelling conidia. Spot blotches on leaves are best caused by high relative humidity, high temperatures, and prolonged leaf wetness (more than 12 to 18 hours) caused by rainfall, irrigation, fog, or dew. Conidia from infected stubble and the soil's surface spread by the wind later in the season, resulting in sores on the leaves and stems. The most important factor, temperature plays a key role coupled with high humidity.

Bipolaris sorokiniana grows best in temperatures between 18°C to 32°C. In the Indo-Gangetic Plains, high relative humidity resulting from high levels of soil residual moisture combined with foggy days permits long hours of wetness on leaf blades, which can last until late January, even at the end of the monsoon and in the absence of rainfall. This creates ideal conditions for the establishment and multiplication of pathogens. During the cropping season, there are several cycles of conidia formation that, when dispersed by wind and water droplets, result in secondary infections. Disease was more severe at 28°C than at lower temperatures, according to numerous scientific reports. Epidemiological studies have shown that timely sowing avoids the physiological stress that often coincides with the flowering stage which in turn reduces spot blotch incidence.

Management

Although there are several approaches to manage spot blotch disease, coordinated management is the most effective. It involves the application of foliar fungicides, biological control, crop rotation, cultural management, seed treatment, and disease-resistant cultivars. Choosing tolerant wheat cultivars like HD 3086, DBW 187, DBW 303, PBW 826, and WH 1270, which naturally sustain far less damage from the fungal infection, is the cornerstone of effective management. Farmers must only use certified, healthy seeds and treat them with potent fungicides like Vitavax Power or Tebuconazole before to sowing in order to prevent early-stage infection. Additionally, incorporating biological control agents such as *Trichoderma harzianum* and *Pseudomonas fluorescens* into the soil or seed treatment helps suppress soil-borne pathogens, improves overall plant health, and naturally boosts the crop's immunity against the disease.

In terms of culture, using appropriate agronomic practices is essential to interfering with the fungus' life cycle. Because too much nitrogen might make the crop more vulnerable to attacks, farmers should be careful to sow their crops on time and apply a balanced dosage of fertilizers. Crop rotation with non-host crops like mustard, lentils, and chickpeas is essential for lowering the pathogen's survivability in the soil, and careful handling of leftover crop wastes removes the main sources of inoculation. Chemical intervention is required when the weather is favorable to the illness and symptoms worsen. As soon as symptoms show, farmers should apply prescribed fungicides, such as Propiconazole, Tebuconazole, or a combination of Azoxystrobin + Tebuconazole, with a special emphasis on safeguarding the

crucial flag leaf. If the disease persists under high humidity, a second spray should be applied 15–20 days after the first one to safeguard final grain production.

Conclusion

Spot blotch, caused by *Bipolaris sorokiniana*, has emerged as a severe threat to global wheat production due to climate change accelerating its spread into new warm and humid zones. The aggressive pathogen causes huge yield losses, shrunken kernels, and leaf necrosis because it thrives in high humidity. It is no longer adequate to use a single management strategy to protect future harvests and guarantee food security. Adopting a thorough framework for integrated disease management is essential for farmers. The greatest sustained resistance is provided by combining climate-resilient cultivars such as HD 3086 with biological control agents, timely sowing, non-host crop rotations, and targeted fungicide applications. This all-encompassing strategy reduces active crop damage, efficiently controls soil-borne diseases, and protects wheat yields over the long term against environmental changes.