

PP1249 (Revised August 2021)

## Fungal Leaf Spot Diseases of Wheat: Tan spot, *Septoria/Stagonospora nodorum* blotch and *Septoria tritici* blotch

Three important fungal leaf spot diseases, tan spot, *Septoria/Stagonospora nodorum* blotch (SNB) and *Septoria tritici* blotch (STB), commonly occur (often as a complex) in North Dakota and have the potential to reduce test weight and yield by 50 percent. Among these, tan spot is the most common leaf spot disease found in all wheat classes throughout North Dakota. Although SNB and STB are found commonly, symptoms generally appear after flag leaf emergence.

### Tan Spot

**Causal agent:** *Pyrenophora tritici-repentis*

The fungal pathogen can produce at least three host-selective toxins (HST) that will induce necrosis (browning) or chlorosis (yellowing) on the leaf and aid in the infection process. Based on the HST they produce, the pathogen has been classified into eight races. Race 1 is the most prevalent in North Dakota and in many other wheat-growing regions of the world.

### Symptoms and Signs

**Leaves:** Early in the season, the fungus will infect and produce small, oval to diamond-shaped spots (1/8 to 1/2 inch long and 1/16 to 1/18 inch wide) that will be found sporadically on wheat leaves. These spots will enlarge and turn tan, often with a yellow border, and have a small dark brown spot resembling an “eyespot” near the center (Figure 1). The eyespot symptom is best observed when holding the leaf up to the sunlight.

**Kernels:** Leaf infections caused by the tan spot pathogen are most common in North Dakota, but kernel infections also can occur. Infected kernels can develop a reddish discoloration on the seed coat, which commonly is called “red smudge” (Figure 2). Red smudge-affected kernels are generally plump, not shriveled, and the discoloration may result in some market discounts. Red smudge symptoms are the result of prolonged wet periods and high humidity during kernel development.

### Disease cycle

The tan spot pathogen overwinters as black pinhead-sized fruiting structures (pseudothecia) that develop on last season’s wheat residue (Figure 3). Asexual spores (conidia) also can be produced on previous crop residue and within existing leaf spots.

In the spring and early summer, spores are dispersed by wind, germinate and infect wheat in a wide range of temperatures.

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Figure 1. Wheat leaves with tan spot symptoms; note tan, necrotic center with yellow halo. (NDSU photo)



Figure 2. Comparison of durum seeds exhibiting “red smudge” symptoms (left and middle) and healthy durum (right). (NDSU photos)

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During prolonged wet periods (24 hours or greater), large numbers of conidia form in the disease spots, and conidia may be blown onto other wheat leaves to form new infections (Figures 4 and 5).

## Septoria/Stagonospora nodorum Blotch (SNB)

**Causal agent:** *Parastagonospora nodorum* (previously named *Septoria nodorum*, *Stagonospora nodorum*)

The fungal pathogen also can produce multiple HST that enhance disease development. The level of susceptibility in wheat varieties is dependent on the type and amount of HST produced by the SNB pathogen.



Figure 3. Notice the fungal structure size difference between the tan spot and Septoria/Stagonospora pathogens (top image). Overwintering structures for the tan spot fungus on wheat residue (bottom image). (NDSU photos)



## Symptoms and Signs

**Leaves:** *Parastagonospora nodorum* initially causes water-soaked and small chlorotic lesions on the lower leaves of the plant. The lesions become yellow and eventually red brown. Mature lesions are generally lens-shaped without the distinct yellow border typical of tan spot lesions (Figure 6). As the disease progresses, the lesions develop an ashen gray-brown center containing brown-black pepper grains (pycnidia), which are sometimes difficult to see in brown lesions. Pycnidia are the asexual reproducing structure of the fungus and are diagnostic of this disease.

**Grain head and kernels:** After flowering, wet weather can lead to lesion development on the glumes. Symptoms often start at the tip, but whole areas of the glumes may be covered with dark brown to dark purple lesions with ash gray areas. This phase of the disease is called “glume blotch” (Figure 7). Severe leaf blotch or glume blotch infections may result in lightweight, shriveled kernels (Figure 8).

## Disease cycle

The life cycle for SNB is very similar to that observed for tan spot (Figure 5). The overwintering reproductive structures (pseudothecia) or asexual structures (pycnidia) are similar in appearance to those of the tan spot fungus, but they are smaller (Figure 4).

The fungus survives on wheat straw, infested seed or an overwintering crop. Ascospores released from the pseudothecia generally cause the first infections. Pycnidia release conidia, which are water-splash dispersed. The fungal spores generally require 12 to 18 hours of leaf wetness for infection, and the disease develops most rapidly between 68 and 81 degrees F.

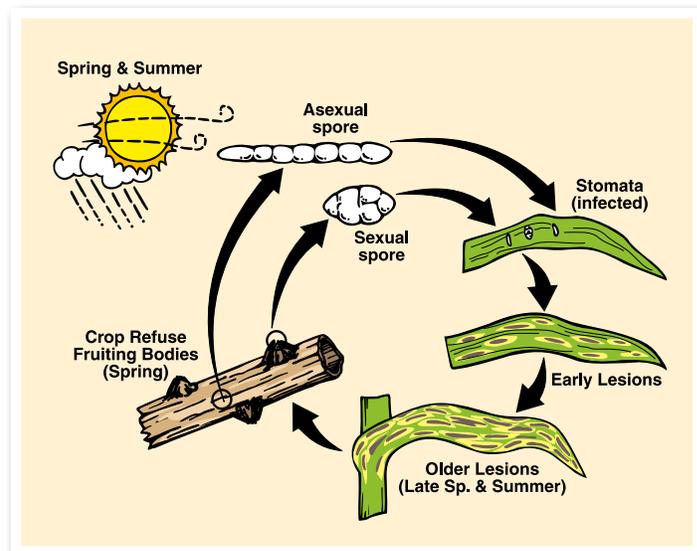


Figure 5. Disease cycle of tan spot on wheat. (NDSU illustration)

Figure 4. Prolonged moisture periods will favor the development of tan spot in the lower canopy of developing wheat. (NDSU photo)

# Septoria tritici Blotch (STB)

## Causal agent:

*Zymoseptoria tritici* (previously named *Septoria tritici*)

## Symptoms and Signs

**Leaves:** Initial symptoms of Septoria tritici blotch (STB) develop on the lower leaves as chlorotic flecks and expand into irregular brown lesions. The lesions are restricted to the leaf veins, giving the appearance of parallel sides. More importantly, lesions are associated with the presence of visible pycnidia that are sphere or ball-shaped, gelatinous and gray-brown. White to cream-colored masses of spores can be seen oozing from matured pycnidia (Figure 9 close-up). Differentiating STB from SNB can be difficult and often requires microscopic observations.

## Disease cycle

*Zymoseptoria tritici* can survive for several years in the form of vegetative strands (mycelium), pycnidia and/or perithecia in wheat residues. Sexual spores (ascospores) from pseudothecia and asexual spores (pycnidiospores) from

pycnidia are released and dispersed by wind or rain splash during the wheat-growing season and can initiate infections under favorable environmental conditions. *Z. tritici* requires more than 24 hours of wetness and is most destructive between 50 and 68 degrees F.

## Disease Management for Tan Spot, SNB and STB

Integrated disease management is the best approach to reduce losses attributed to the foliar leaf spot complex (Figure 10). These include a combination of host plant resistance, seed quality, crop rotations, residue management and fungicides.



Figure 6. Symptoms of SNB. Notice the lens-shaped lesions with ashen gray centers and black specks (pycnidia). (NDSU photo)

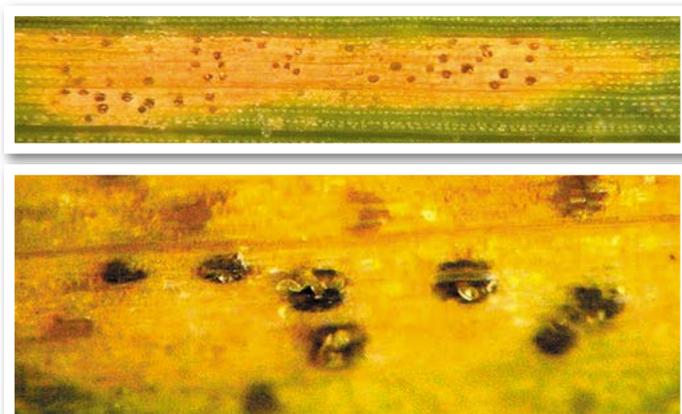


Figure 9. Fruiting structures of the STB pathogen. (NDSU photos)

Figure 7. Glume blotch symptoms caused by *Septoria/Stagonospora*. Notice the dark brown to purple blotches on the glumes. (NDSU photo)



Figure 10. When fungal leaf spot diseases are not managed, significant damage can occur on the flag leaves. (NDSU photo)

Figure 8. Shriveled durum kernels (left) caused by SNB and normal durum kernels (right). (NDSU photo)





## Host Plant Resistance

Some spring wheat and durum cultivars have good resistance to these fungal leaf spot pathogens, but other cultivars may range in response from susceptible to moderately resistant. Growers are advised to consult the most recent reports of their nearest NDSU Research Extension Centers or the NDSU Extension variety trial publications for current information about cultivar response to fungal leaf spot diseases in North Dakota. The use of a resistant cultivar reduces the risk of yield and quality losses.

**Seed Quality:** Good-quality and pathogen-free seed should be used for planting. Planting seed infested with these fungal leaf spot pathogens can result in reduced germination and poor seedling vigor.

**Seed Treatments:** Effective seed treatment fungicides are available and can reduce the risk of seedling infections that might arise from planting infected seed. Consult the latest editions of NDSU Extension publication PP622, “North Dakota Field Crop Plant Disease Management Guide,” for seed treatment products registered for wheat.

## Crop Rotations and Residue Management

**Crop rotations** can reduce the initial inoculum of fungal leaf spot pathogens. Wheat disease surveys in North Dakota indicated that tan spot and the Septoria diseases were more prevalent in the areas where small grains were the previous crop than if a broadleaf crop previously had been grown. Rotating spring wheat, winter wheat or durum with any broadleaf crop will reduce the risk of infection by these three-leaf spot fungi.

Additionally, planting wheat into the residue of oats, millet and barley reduces the risk of fungal leaf spot development, but their residue may be inoculum sources for other diseases of wheat such as *Fusarium* head blight (scab). Corn is not a host of these leaf spot fungi, but planting wheat into corn residue dramatically increases the risk of scab.

**Residue management** may involve tillage to bury infested residue or straw management at harvest to aid residue decomposition. Tillage generally is not a recommended practice in North Dakota because of the potential loss of soil moisture or soil organic matter through wind erosion. Chisel plowing may reduce residue cover, but enough wheat residue is usually left to be a potential inoculum source.

## Disease Forecasting

The scouting-based NDSU small-grain disease forecasting system provides information for the risk of tan spot, SNB and STB infections at the following website:  
[www.ag.ndsu.nodak.edu/cropdisease/](http://www.ag.ndsu.nodak.edu/cropdisease/).

The forecasting system is a useful tool to indicate the possible need for fungicide application. This forecasting system determines if weather has been favorable for infection at North Dakota Agricultural Weather Network (NDAWN) sites across the state. The grower must decide if the variety grown is susceptible to the leaf disease, if good yield potential is present to warrant fungicide use and if the NDAWN site chosen is representative of the weather in the vicinity of the wheat field.

## Fungicides

Fungicides are available for early and late-season management of leaf spot diseases. Tank mixing a fungicide and herbicide for a four to six-leaf stage application is a common practice in North Dakota.

NDSU research has shown modest (2 to 6 bushel) yield responses with the application of reduced rates of fungicide for early season tan spot when: (1) wheat was planted into wheat residue, (2) a susceptible to moderately susceptible variety was grown and (3) spring rains and cool weather favored disease development. Early season fungicide application is not recommended in the absence of disease or in an unfavorable environment.

Several fungicides are labeled for the management of tan spot and the Septoria complex, and recommendations are found in the “North Dakota Field Crop Plant Disease Management Guide.” Another source of information is the fungicide efficacy table organized by the North Central Regional Committee on Management of Small Grain Diseases (NCERA-184) and can be found on the NDSU Extension plant pathology website: [www.ag.ndsu.edu/extplantpath](http://www.ag.ndsu.edu/extplantpath).

Foliar fungicides may be applied with aerial or ground equipment. Five gallons of water per acre is recommended for air; ground application generally requires 10 to 20 gallons of water per acre.

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