

Fungal Leaf Spot Diseases of Wheat:

Tan spot, *Stagonospora nodorum* blotch and *Septoria tritici* blotch

Marcia McMullen
Extension Plant Pathologist,
Department of Plant Pathology

Tika Adhikari
Wheat Pathologist,
Department of Plant Pathology

Three important fungal leaf spot diseases, tan spot, *Stagonospora nodorum* blotch (SNB) and *Septoria tritici* blotch (STB), commonly occur in North Dakota and can cause reduced test weights and yield losses of up to 50 percent. Among these, tan spot, caused by *Pyrenophora tritici-repentis*, is the most destructive leaf spot disease found in all wheat classes throughout the growing season across North Dakota. SNB and STB also are common in wheat in North Dakota each year, but symptoms generally appear after flag leaf emergence.



Figure 1. Tan spot infections on wheat leaves; note tan necrosis spot in center and yellow halo.

Tan Spot

Causal agent:
Pyrenophora tritici-repentis

Eight races (often genetically and geographically distinct groups) of *P. tritici-repentis* have been identified on the basis of necrosis (browning) and/or chlorosis (yellowing) symptoms induced on a set of designated wheat cultivars. Among the races, race 1 is the most prevalent in North Dakota. These races produce different host-selective toxins (HSTs) on susceptible wheat varieties.

Symptoms and Signs

Leaves: The fungus produces oval or diamond-shaped to elongated irregular spots (1/8 to 1/2 inch long and 1/16 to 1/18 inch wide). These spots enlarge and turn tan with a yellow border and a small dark brown spot near the center (Figure 1). The dark spot is best observed by holding the leaf up to the light. This pattern of a tiny dark spot in a tan lesion and

NDSU

NDSU Extension Service
N.D. Agricultural Experiment Station

North Dakota State University
Fargo, North Dakota 58105

February 2009

a narrow to broad yellow border produces an “eyespot” type of symptom, which is usually distinctive for the disease. Early in the season, tan spot lesions often have a very distinctive, large chlorotic (yellow) border (Figure 2).

Kernels: Leaf infections caused by tan spot are common in North Dakota; however, kernel infection can occur. Infected kernels can develop a reddish discoloration on the seed coat, which commonly is called “*red smudge*” (Figure 3). Red smudge-affected kernels are generally plump, not shriveled, but 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 stems (Figure 4). Pseudothecia release sexual spores (ascospores) in spring and early summer. Asexual spores (conidia) are produced on previous crop residue and leaf spots. Both spores are dispersed by wind, and germinate and infect wheat in a wide range of temperatures. During wet growing seasons, large numbers of conidia form in the disease spots and these conidia may be wind-borne to other wheat leaves to form new infections (Figure 5). Prolonged wet periods (24 hours or greater) can result in spore germination and infection on wheat leaves.



Figure 2. Tan spot lesions on lower leaves of young plants, and wheat stubble from the previous year’s crop.

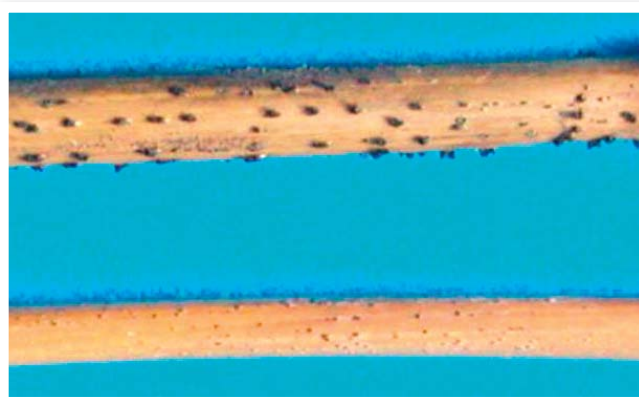


Figure 3. Tan spot-infected durum seeds exhibit “red smudge” symptoms (left and middle) and healthy durum (right).



Tan spot

Stagonospora nodorum



Top: tan spot

Bottom: *Stagonospora nodorum*

Figure 4. Fungal structures of the tan spot fungus and *Stagonospora nodorum* on wheat straw. (Photos by Carl Bradley, previously with NDSU Extension Service)

Stagonospora Nodorum Blotch (SNB)

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

Symptoms and Signs

Leaves: *Stagonospora 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 specks (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, often starting at the tip, but whole areas of the glumes may be covered with dark brown to dark purple 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 in size (Figure 4). The fungus survives in wheat straw, infested seed or

an overwintering crop. Ascospores released from the pseudothecia generally cause the first lesions. Pycnidia release conidia, which are water-splash dispersed. *Stagonospora nodorum* blotch spores generally require 12 to 18 hours of leaf wetness for infection, and the disease develops most rapidly between 68 and 81 degrees Fahrenheit.



Figure 6. Lens-shaped lesions with ashen gray centers, typical of infections by SNB. (Some scattered leaf rust pustules also are present on leaf.)



Figure 7. Glume blotch symptoms caused by SNB infections. Note brown-ing of glumes and brown infected spots on awns.

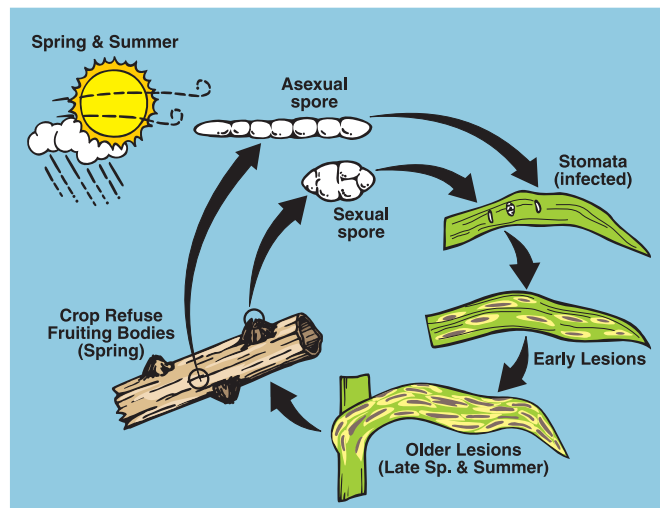


Figure 5. Disease cycle of tan spot on wheat.



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

Septoria Leaf Blotch (STB)

Causal agent: *Septoria tritici*

Symptoms and Signs

Leaves: Initial symptoms of STB develop on the lower leaves as chlorotic flecks and expand into irregular brown lesions (Figure 9). 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. The white to cream masses of spores can be seen oozing from matured pycnidia (Figure 9 close-up) and are reliable diagnostic signs for distinguishing Septoria leaf blotch infection from Stagonospora nodorum blotch.

Disease cycle

Septoria tritici can survive for several years in the form of vegetative strands (mycelium), pycnidia and perithecia in wheat residues. Sexual spores (ascospores) from perithecia and asexual spores (pycnidiospores) from pycnidia are released and dispersed by either wind or splash rain during the wheat-growing season and can initiate infections under favorable environmental conditions. *S. tritici* requires more than 24 hours of wetness and is most destructive between 50 and 68 F.

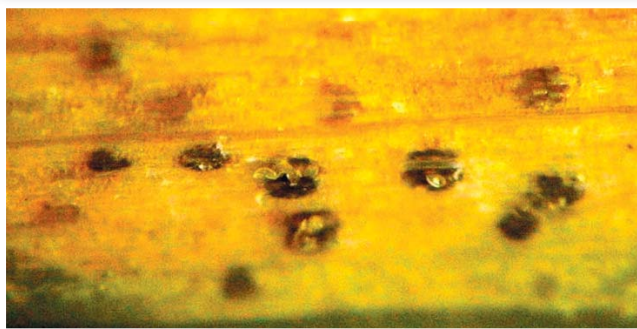
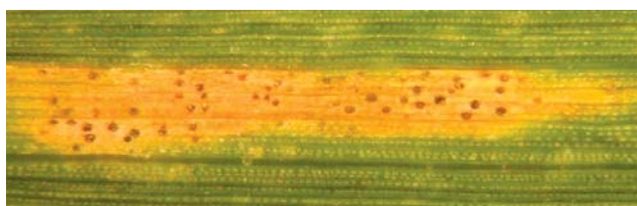


Figure 9.

Disease Management for Tan Spot, SNB and STB

Integrated disease management is the best approach to reduce losses due to fungal leaf spot diseases in wheat. These include a combination of host plant resistance, seed quality, crop rotations and fungicide methods.

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. New spring wheat and durum cultivars are released each year and 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. 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 a red smudge seed. Please consult the latest editions of NDSU Extension publication PP-622, “North Dakota Field Crop Fungicide 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 *Stagonospora*/*Septoria* diseases were more prevalent in the areas where small grains were the previous crop than if a broadleaf crop previously had been grown. Rotation of spring wheat or durum with any broadleaf crop will reduce the risk of infection by these three leaf spot fungi. Planting into the residue of oats, millet and barley also pose little risk for these fungi, but their residue may be sources of some other pathogens that also go to wheat. Corn is not a host of these leaf spot fungi, but planting wheat into corn residue dramatically increases the risk of *Fusarium* head scab infection.

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 often enough wheat residue is left to be a potential source of fungal leaf spot spores the following growing season.

Disease Forecasting

The NDSU small-grain disease forecasting system provides information for the risk of tan spot, SNB and STB infections at the following Web site:

www.ag.ndsu.nodak.edu/cropdisease/.

The forecasting system is a useful tool to indicate 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 both early season control of tan spot and for later season control of all three leaf spot diseases. NDSU research has shown modest (2- to 6-bushel) yield responses with application of reduced rates of fungicide to wheat for control of early season tan spot when: 1) wheat was planted into wheat residue, 2) a susceptible to moderately susceptible variety was grown and 3) when spring rains favored disease development. Early season application is not recommended as a standard practice in the absence of disease or favorable environment, and reduced-rate applications are not recommended in other crops.

Protectant fungicides, such as those containing mancozeb (Dithane products, Manzate 200, Manex II, Penncozeb products, Manzate 75, etc.), copper (Kocide, Champ) or combination products of mancozeb + copper (ManKocide) provide a layer of protection against infection if they are present prior to the spores landing on the leaf surface. They need to be in place before infection occurs. Protectant fungicides generally are effective only from seven to 10 days because they degrade with rain and sunlight. Two applications of protectants may be needed for longer season protection, and they generally need the addition of a spreader/sticker product.

Locally systemic fungicides, such as triazoles and strobilurins, have very good to excellent activity against the leaf spot diseases of wheat. Products with mixtures of these two classes of chemistry also are available. For some, half the full label rates have been used for early season tan spot control, generally applied at the four- to five-leaf stage, but this is a practice only recommended for tan spot of wheat under certain environmental conditions: i.e. wet weather, susceptible variety and some wheat residue present. Check fungicide and/or herbicide labels for allowed tank mixes for this early season use. Full label rates of fungicides generally are applied to protect the flag leaf from boot stage (Feekes 10) to flowering (Feekes 10.51). The flag leaf is an important source of nutrients transmitted to kernels for grain fill.

The following table provides information on the newer fungicide chemistries available in North Dakota for fungal leaf spot control in wheat and durum. Please consult the most current edition of PP-622, "North Dakota Field Crop Fungicide Guide," for updated information on registered fungicides.

Newer fungicide chemistries for fungal leaf spot control in spring and durum wheat

Class*	Active Ingredient	Product	Full Label Rate/A Fl oz	Harvest restrictions
Strobilurins (Class 11)	Azoxystrobin 22.9%	Quadris 2.08 SC	6.2 – 10.8	45 days
	Pyraclostrobin 3.6%	Headline 2.09 EC	6 – 9	Feekes 10.5
	Metconazole 8.6%	Caramba	10 – 17	30 days
Triazoles (Class 3)	Propiconazole 41.8%	Tilt 3.6 Ec PropiMax 3.6 EC Bumper 41.8 EC	4	40 days
	Prothioconazole 41%	Proline 480 SC	5 – 5.7	30 days
	Tebuconazole 38.7%	Folicur 3.6 F Embrace 3.6 L Monsoon Muscle 3.6 F Orius 3.6 F Tebucon 3.6 F Tebustar 3.6F Tebuzol Tegrol Toledo, others	4	30 days
	Prothioconazole 19% Tebuconazole 19%	Prosaro 421 SC	6.5 – 8.5	30 days
	Metconazole 7.4% Pyraclostrobin 12%	Multiva or TwinLine	6 – 11	Feekes 10.5
Mixtures of triazoles + strobilurins (Classes 3 and 11)	Propiconazole 11.7% Asozystrobin 7.0%	Quilt 200 SC	14	45 days
	Propiconazole 11.4% Trifloxystrobin 11.4%	Stratego 250 EC	5 - 10	35 days

* Class indicates class of chemistry and fungicide resistance group.

Please check individual labels for further information on recommendations for use of spreader stickers, tank mixes allowed, timing of application, and possible grazing or feeding restrictions. **Above table derived from one prepared by the North Central Regional Committee on Management of Small Grain Diseases, NCERA-184.**

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

The NDSU Extension Service does not endorse commercial products or companies even though reference may be made to tradenames, trademarks or service names.

This publication may be copied for noncommercial, educational purposes in its entirety with no changes. Requests to use any portion of the document (including text, graphics or photos) should be sent to permission@ndsuext.nodak.edu. Include exactly what is requested for use and how it will be used.

For more information on this and other topics, see: www.ag.ndsu.edu

County commissions, North Dakota State University and U.S. Department of Agriculture cooperating. North Dakota State University does not discriminate on the basis of race, color, national origin, religion, sex, disability, age, Vietnam Era Veterans status, sexual orientation, marital status, or public assistance status. Direct inquiries to the Chief Diversity Officer, 205 Old Main, (701) 231-7708. This publication will be made available in alternative formats for people with disabilities upon request, (701) 231-7881.

2M-2-09