Small Grains

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Small Grain Diseases

Disease management is critical for those interested in maximizing small grains yields and grain quality. Many diseases attack small grains in the mid-Atlantic and several significantly impact yields in disease favorable years. This section discusses how to manage diseases growers and consultants will encounter in mid-Atlantic small grains fields. Remember, management starts with accurate diagnosis. Contact your local Extension Agent, plant disease diagnostic clinic, or Extension Specialist for assistance with identifying and diagnosing issues in your small grains.

Table 3.10 - Effectiveness of Management and Cultural Practices on Diseases of Wheat

Diseases	Sanitation	Crop rotation	Planting date	Balanced fertility	Disease free seed	Resistant cultivars	Fungicide Seed	Fungicide Foliar	Insecticide Seed
Powdery mildew	-		2[1]	3	-	1	1	1	-
Leaf rust	-	-	3	-	-	1	3	1	-
Leaf and glume blotch	2	2	-	-	2	3	2	1	-
Tan spot	2	2	-	-	-	3	-	2	-
Loose smut	-	-	-	-	1	-	1	-	-
Head scab[2]	3	2	3	-	-	2	-	2	-
Take-all	2	1	3	3	-	-	-	-	-
Barley yellow dwarf	-	-	1	-	-	2	-	-	1
Wheat spindle streak	-	-	2	-	-	1	-	-	-
Wheat streak mosaic virus	1	2	-	-	-	-	-	-	-

[1]1 = highly effective; 2 = moderately effective; 3 = slightly effective; and - = no effect in reducing disease.

[2]Seed infested with the head scab fungus will produce weak seedlings that are prone to seedling blight. A fungicide seed treatment may be of some benefit if germination rates are acceptable. Scabby seed does not produce head-scabbed plants.

Table 3.11 - Effectiveness of Management and Cultural Practices on Diseases of Barley

Diseases	Sanitation	Crop rotation	Planting date	Balanced fertility	Disease free seed	Resistant cultivars	Fungicide Seed	Fungicide Foliar	Insecticide Seed
Covered smut	-	-	-	-	1[1]	2	1	-	-
Loose smut	-	-	-	-	1	2	1	-	-
Powdery mildew	-	-	2	3	-	1*	2	1	-
Leaf rust	-	-	2	-	-	1	3	1	-
Barley scald	1	1	-	-	-	1	-	1	-
Net blotch	1	1	-	-	-	1	2	1	-
Head scab[2]	1	2	3	-	-	-	-	2	-
Barley stripe	2	3	-	-	1	2	1	-	-
Barley yellow dwarf	-	-	2	-	-	1	-	-	1

[1]1 = highly effective; 2 = moderately effective; 3 = slightly effective; and - = no effect in reducing disease.

[2]Seed infested with the head scab fungus will produce weak seedlings that are prone to seedling blight. A fungicide seed treatment may be of some limited benefit if germination rates are acceptable. Scabby seed does not produce plants with head scab.

* The powdery mildew population has been shifting and some varieties that were previously resistant may now be suceptible to thie disease. An example of this occuring can be seen in Thoroughbred.

Managing Seed and Seedling Diseases of Small Grains

Some diseases such as loose smut, stinking smut, ergot, and some Fusarium diseases can be transmitted in or on seed. These diseases can potentially cause losses, although infrequently, in Mid-Atlantic small grains. Fungicide seed treatments, properly applied, can be considered inexpensive stand establishment insurance. Seed treatments minimize losses from seed decay, seedling blights, and seed and soil borne diseases, and for small grains are the only means of combating the smut diseases. There are currently numerous seed treatment fungicides that are available for small grains. Many of these chemicals must be applied by certified seed treatment applicators. Consult with your chemical or seed salesperson or agricultural supply dealer for product information. Hopper-box or slurry applications are still available.

Foliar Fungicides in Small Grains

The North Central Regional Committee on Management of Small Grain Diseases (NCERA-184) has developed the following information on fungicide efficacy for control of certain foliar diseases of wheat for use by the grain production industry in the U.S. Efficacy ratings for each fungicide listed in the table were determined by field testing the materials over multiple years and locations by the members of the committee. Efficacy is based on proper application timing to achieve optimum effectiveness of the fungicide as determined by labeled instructions and overall level of disease in the field at the time of application. Differences in efficacy among fungicide products were determined by direct comparisons among products in field tests and are based on a single application of the labeled rate as listed in the table. Table 3.12 includes most widely marketed products, and is not intended to be a list of all labeled products.

Table 3.12 - Efficacy of Fungicides for Wheat Disease Control Based on Appropriate Application Timing

Fungicide(s)				Powdery mildew	Stagonospora leaf/glume blotch	Septoria leaf blotch	Tan spot	Stripe rust	Leaf rust	Stem rust	Head scab	Harvest Restriction
Class	Active ingredient(s)	Product	Rate/A (fl. oz)									
Strobilurin	Picoxystrobin 22.5%	Aproach SC	6.0 - 12	G[1]	VG	VG[2]	VG	E[3]	VG	VG	NL	Feekes 10.5
	Fluoxastrobin 40.3%	Evito 480 SC	2.0 – 4.0	G	--	--	VG	--	VG	--	NL	Feekes 10.5 and 40 days
	Pyraclostrobin 23.6%	Headline SC	6.0 - 9.0	G	VG[2]	VG[2]	E	E[3]	E	G	NL	Feekes 10.5
Triazole	Metconazole 8.6%	Caramba 0.75 SL	10.0 - 17.0	VG	VG	--	VG	E	E	E	G	30 days
	Propiconazole 41.8%	Tilt 3.6 EC[4]	4.0	VG	VG	VG	VG	VG	VG	VG	P	Feekes 10.5
	Prothioconazole 41%	Proline 480 SC	5.0 - 5.7	--	VG	VG	VG	VG	VG	VG	G	30 days
	Tebuconazole 38.7%	Folicur 3.6 F[4]	4.0	NL	NL	NL	NL	E	E	E	F	30 days
	Prothioconazole19% Tebuconazole 19%	Prosaro 421 SC	6.5 - 8.2	G	VG	VG	VG	E	E	E	G	30 days
Mixed modes of action[5]	Metconazole 7.4% Pyraclostrobin 12%	TwinLine 1.75 EC	7.0 – 9.0	G	VG	VG	E	E	E	VG	NL	Feekes 10.5
	Fluxapyroxad 14.3% Pyraclostrobin 28.6%	Priaxor	4.0 - 8.0	G	VG	VG	E	VG	VG	G	NL	Feekes 10.5
	Propiconazole 11.7% Azoxystrobin 13.5%	Quilt Xcel 2.2 SE[4]	10.5 - 14.0	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5
	Prothioconazole 10.8% Trifloxystrobin 32.3%	Stratego YLD	4.0	G	VG	VG	VG	VG	VG	VG	NL	Feekes 10.5 35 days
	Cyproconazole 7.17% Picoxystrobin 17.94%	Aproach Prima SC	3.4-6.8	VG	VG	VG	VG	E	VG	--	NR	45 days
	Tebuconazole 22.6% Trifloxystrobin 22.6%	Absolute Maxx SC	5.0	G	VG	VG	VG	VG	E	VG	NL	35 days
	Fluoxastrobin 14.8% Flutriafol 19.3%	Fortix	4.0 – 6.0	--	--	VG	VG	E	VG	--	NL	Feekes 10.5 and 40 days
	Benzovindiflupyr 10.3% Propiconazole 11.7% Azoxystrobin 13.5%	Trivapro A EC + Trivapro B SE	4.0 + 10.5	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5.4

[1]Efficacy categories: NL=Not Labeled; NR=Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; -- = Insufficient data to make statement about efficacy of this product.

[2] Product efficacy may be reduced in areas with fungal populations that are resistant to strobilurin fungicides.

[3]Efficacy may be significantly reduced if solo strobilurin products are applied after stripe rust infection has occurred.

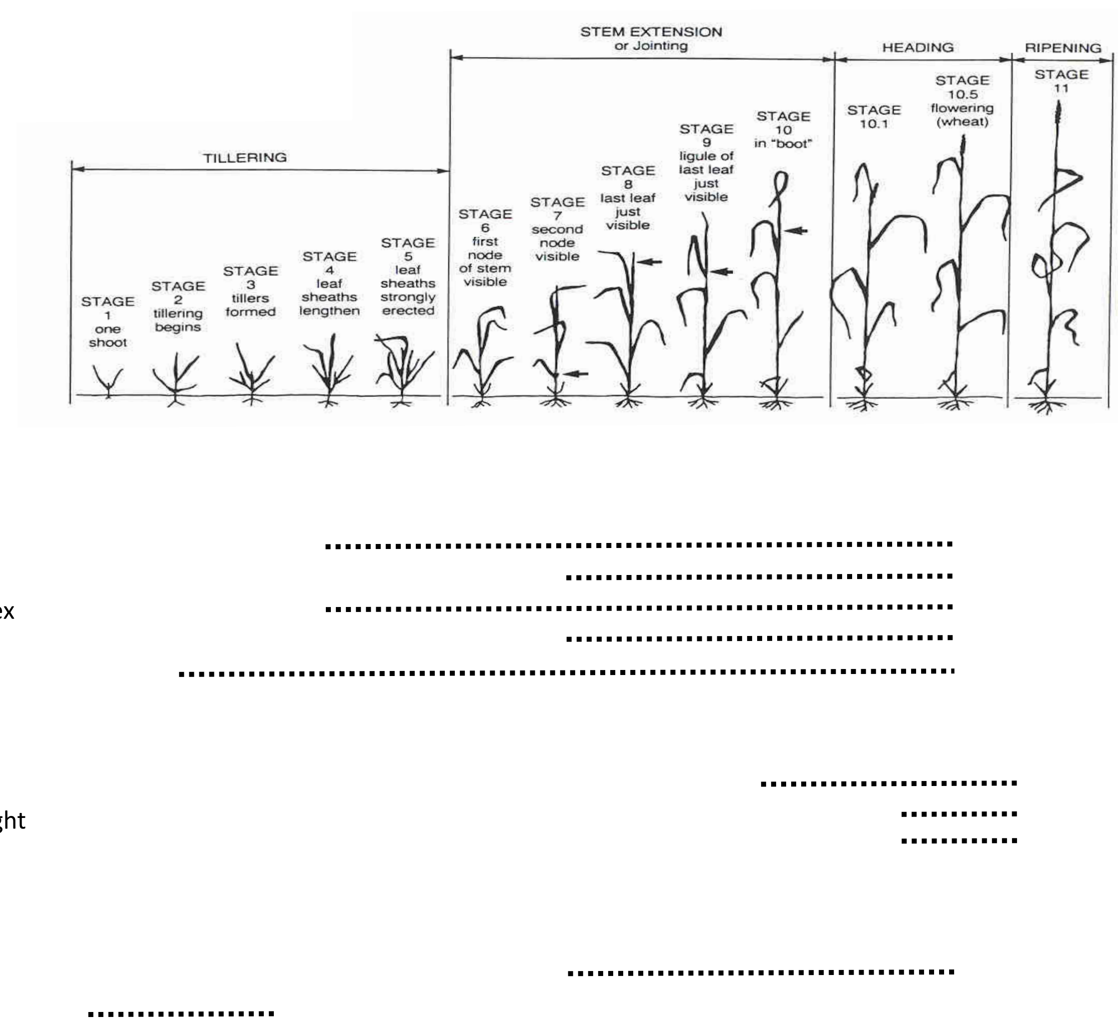
[4]Multiple generic products containing the same active ingredients also may be labeled in some states.

[5]Products with mixed modes of action generally combine triazole and strobilurin active ingredients. Priaxor and the Trivapro copack include carboxamide active ingredients.

Fungicides are not needed in every field every year and the use of fungicides may not always be profitable. Although some individuals claim that fungicides may boost yield in situations where diseases are absent, university research indicates this is not the case. Foliar fungicides are likely to be most profitable in 1) high yield settings (70+ bu/A); 2) fields where susceptible varieties are planted and scouting indicates threshold levels of disease are present; 3) the stage of crop growth is suitable for treatment; and 4) the forecast indicates that conditions will be favorable for continued disease development, in particular long periods of humid or rainy weather.

Scouting Small Grains for Disease

Scouting fields is an easy way to ensure that you are staying on top of yield-robbing diseases. Growers who scout their fields will benefit from scouting by 1) being able to make pesticide applications in a timely manner and 2) learning about the disease issues associated with a particular field or variety. This information can be used in future seasons to better maximize productivity. There are many diseases that can impact mid-Atlantic small grains, but seldom do they all attack at the same time. Specific diseases occur at certain times of the year when the environment is conducive or he plant growth stage is susceptible to disease.



Scouting Calendar for Major Diseases of mid-Atlantic Small Grains

Diseases of Small Grains

Virus Diseases

Scouting: Examine fields at least once a month during active growing periods from Feekes 2 through Feekes 10.5. Scout at least 1 site per 10 acres of field. At each site observe plants within a 5-10 foot radius.

General Symptoms: Stunted, deformed plants. Foliage may be streaked or mottled. Leaf discoloration (red/orange). Entire fields are rarely affected. Instead look for single or small groups of plants in patches.

Diagnosis: Specialized tests that can be conducted by the Plant Disease Clinic or special testing services such as Agdia Inc.

Barley Yellow Dwarf

Barley yellow dwarf virus (BYDV) is the most widely distributed and destructive of the viral diseases that affect wheat. Symptoms of BYDV are often confused with various nutritional or non-biological disorders. Leaf discoloration induced by the virus infection typically ranges from shades of yellow to red and sometimes purple, especially extending from the leaf tip to the base and from the leaf margin to the mid-rib. Seedling infections have the greatest impact on yield. Plants infected in the fall may not survive the winter or are severely stunted and discolored when growth resumes in the spring. These diseased plants often occur in circular patches within the field. These patches are associated with the feeding and colonization by aphid vectors in the fall and early spring. Grain yields from such plants have been reduced by 30 to 35 percent in experimental plots in Virginia. The virus can be transmitted by more than 20 species of aphids (five species of which are known to occur in Virginia). The virus persists in small grains (barley, oats, rye, and wheat), in corn, and in over 80 species of perennial and annual grasses. The spread of this virus is entirely dependent on the activity of the aphid vectors. The environmental conditions that favor BYDV epidemics are cool temperatures (50˚ to 65˚F) with rainfall that supports wheat and grass growth as well as aphid reproduction and movement. Infections can occur throughout the season and are most abundant where high populations of aphids survive the winter. The leaf discoloration symptoms indicating virus infection develop within about two weeks of inoculation at temperatures between 65˚ to 70˚F. When infections occur at temperatures above 85˚F, symptoms do not develop.

Management: Plant after the Hessian fly-free date. Plant varieties tolerant to BYDV. Manage aphids in the fall via insecticide seed treatments. Foliar insecticides may provide some benefit if aphid populations increase past threshold levels in the fall, within a month of planting, or in early spring.

Wheat Spindle Streak Mosaic Virus (Wheat Yellow Mosaic)

Wheat spindle streak mosaic virus (WSSMV) is common in some fields in Virginia. Symptoms are typically expressed in leaves as yellow-green mottling with parallel dashes or streaks with tapered ends—hence the name wheat spindle streak. The virus is transmitted to wheat by a soil-borne fungus, *Polymyxa graminis*, which, in the absence of wheat, is associated with the roots of grassy weeds and other monocot crops (e.g., barley, corn, millet, rye, sorghum, etc.). Most significant infections take place during cool, wet periods in the fall. Often large areas of a field may be affected. Infection does not occur at temperatures above 68˚F. Thus, an increase in temperature allows the plant to outgrow the virus and may mask symptoms later in the growing season. The optimal temperature for symptom expression is between 48˚ and 55˚F. The earlier in the life of the wheat plant that infection occurs, the more severe the symptom expression. During cool spring conditions, the yellow spindle streaks may become necrotic. Affected plants may be mildly stunted and produce fewer tillers and seeds per head.

Management: Plant resistant wheat varieties. Plant after the Hessian fly-free date. Improve soil drainage and improve compaction in problem fields.

Wheat Streak Mosaic Virus

Wheat streak mosaic virus (WSMV) was observed for the first time in more than 25 years during the 2000 growing season. The incidence and severity of this disease depends on the environment, vector survival, distribution and frequency of volunteer wheat plants that serve as a source of virus and a haven for the vector, and wheat cultivar susceptibility. Symptoms of wheat streak mosaic virus typically appear in the spring. These symptoms can look very similar to wheat spindle streak caused by WSSMV. However, the field pattern of WSMV is related to the distribution and activity of the vector, the wheat curl mite, *Aceria tulipae*. As the wheat crop develops, plants affected with WSMV are typically severely stunted with yellow mottled and streaked leaves. These yellow streaks are often seen as discontinuous dashes running parallel to the leaf veins. As the season progresses, plants affected and colonized by the curl mites may develop "leaf rolling." Leaves appear upright while the margins roll inward. This symptom of mite feeding looks like drought stress in the affected plants. WSMV symptoms tend to become more severe as the weather warms, and severely affected plants may produce sterile heads or die prematurely. The mite requires living hosts such as volunteer wheat or corn to survive and move to emerging wheat in the fall. Mites can then move to nearby or distant sources into wheat fields, feed on wheat, and can spread the virus.

Management: Eliminate volunteer wheat and corn before wheat emerges in the fall.

Foliar Diseases

Leaf Blotch Complex

Examine the following leaf positions at the indicated growth stage:

Flag-4 and Flag-5 for Zadoks growth stages 31 to 37 and Feekes growth stages 6 to 8 (jointing to flag leaf emergence)

Flag-3 for Zadoks growth stages 38 to 45 and Feekes growth stages 9 to 10 (flag leaf fully expanded to boot)

Flag-2 for Zadoks growth stages 46 to 59 and Feekes growth stages 10.1 to 10.5 (boot splitting to heading)

Scout fields weekly from Zadoks growth stage 31 through 59 (Feekes 6 through 10.5). Randomly select 10 locations within a wheat field. At each location, examine and record the number of indicator leaves out of ten main tillers with one or more leaf and glume blotch lesions. If 25 percent of the 100 indicator leaves in the field have one or more lesions, then a fungicide application may be beneficial.

Scouting: Examine fields at least every other week during active growing periods from Feekes 5 through Feekes 10.5. Scout at least 1 site per 10 acres of field. At each site observe plants within a 5-10 foot radius.

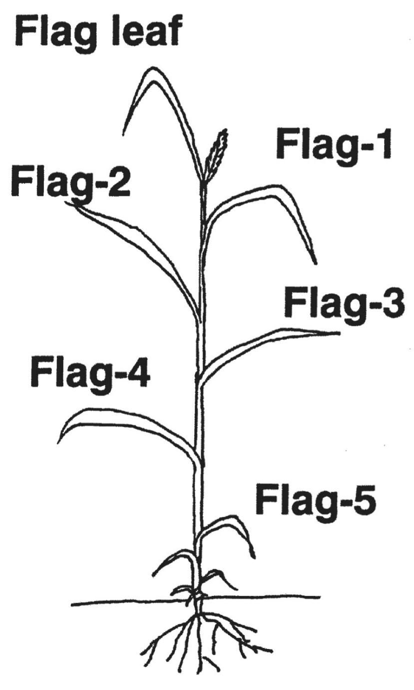


Fig 3.1 Determination of treatment threshold for septoria leaf and glume blotch in wheat.

General Symptoms: Lesions that may be blocky, oblong, or cats-eye in shape and surrounded by a thin yellow halo. *Septoria tritici* lesions tend to follow leaf veins and often contain multiple, black fungal structures within a lesion. Cream-colored cirri can be produced under extended periods of wet or humid weather. Lesions caused by *Stagonospora nodorum* are shaped like a cats-eye and contain very small, brownish colored fungal structures within the lesion. Lesions may be hard to see and can be embedded in the plant tissue. Cirri can also be produced under humid conditions but unlike *S. tritici*, they are salmon colored.

Diagnosis: May be diagnosed by trained individuals in the field with the aid of a hand lens. Confirmation through culturing or other techniques can be carried out by a Plant Diagnostic Clinic.

Description:
Leaf blotch complex is caused by two fungal diseases: *Stagonospora nodorum*, which also causes Glume Blotch, and *Septoria tritici*. Both diseases are residue- and seed-borne and develop first on lower leaves and move up the plant under favorable environmental conditions. *S. tritici* is a cool weather pathogen and is favored by high humidity and temperatures between 59-69°F. *S. nodorum* does best under warmer conditions (69-81°F) and humid weather. Epidemics of both diseases can originate from wind or rain dispersed spores, either from local or distal sources. Infection by *S. nodorum* tends to occur later in the stages of plant development. Both diseases can significantly reduce yields in susceptible varieties and under appropriate environmental conditions. Test weights may also be reduced.

Management: Plant resistant varieties. Varieties with resistance to Stagonospora leaf blotch may not be resistant to glume blotch and vice versa. Plant certified disease free seed and use recommended fungicide seed treatments. Destroy weeds and volunteer wheat or barley in fields prior to planting. If a susceptible variety is planted, foliar fungicides applied after flag leaf emergence can be beneficial if the disease is present and the environment conducive for further disease development.

Tan Spot

Scouting: Examine fields at least every other week during active growing periods from Feekes 5 through Feekes 10.5. Scout at least 1 site per 10 acres of field. At each site observe plants within a 5-10 foot radius.

General Symptoms: Tan spot is caused by *Pyrenophora tritici-repentis* and produces symptoms very similar to Leaf Blotch Complex. Tan spot lesions are cats-eyed shaped but unlike *S. nodorum*, lesions do not often coalesce. The lesions will have dark centers but do not have black or brown fungal structures within lesions.

Diagnosis: May be diagnosed by trained individuals in the field with the aid of a hand lens. Confirmation through culturing or other techniques can be carried out by a Plant Diagnostic Clinic.

Description: *Pyrenophora tritici-repentis* is a residue-borne organism that can infect wheat, barley, rye, and numerous other grassy hosts. Disease occurs over a wide temperature range, but symptoms are often more pronounced at later stages in crop growth. Depending on the variety, as few as 6 hours of leaf wetness may be needed for disease development. The disease spreads through the dissemination of spores in wind and rain.

Management: Same as for Leaf Blotch Complex

Powdery Mildew

Scouting: Examine fields at least every other week during active growing periods from Feekes 2 through Feekes 10.5. Scout at least 1 site per 10 acres of field. At each site observe plants within a 5-10 foot radius.

General Symptoms: White fuzzy growth on stems and foliage of plants. Over time black pinhead-like structures can be observed in and on the white growth. Very old infections appear grey to brown.

Diagnosis: Easily identified with the naked eye in the field.

Description:
Blumeria graminis is common throughout the mid-Atlantic. The fungus overwinters in small grain stubble as well as overwintering wheat and barley. Powdery mildew is favored by cool temperatures (60-68°F) and high relative humidity (>90% RH). Unlike other foliar diseases, free water on the leaf surface may inhibit spore germination and infection. Disease progress ceases at temperatures above 77°F. Disease increases with nitrogen fertilization and lush growth. Spores of powdery mildew can be dispersed on air currents over large distances. Infection can cause lodging as well as yield losses resulting from foliar infection. Population shifts have overcome previously effective resistance genes in barley and this may occur in wheat.

Management: Plant resistant varieties. Avoid planting wheat or barley early in the fall. Avoid excessive nitrogen levels. Foliar fungicides, especially when a susceptible variety is planted and the disease is detected early in the growing season, may be beneficial in some years. Protection of the flag leaf is key.

Rusts (Stripe and Leaf)

Scouting: Examine fields every week during active growing periods from Feekes 2 through Feekes 10.5. Scout at least 1 site per 10 acres of field. At each site observe plants within a 5-10 foot radius. Consider a fungicide application for a high yield crop when rust covers 1 percent of upper, fully expanded leaves prior to heading, Fig 3.2.

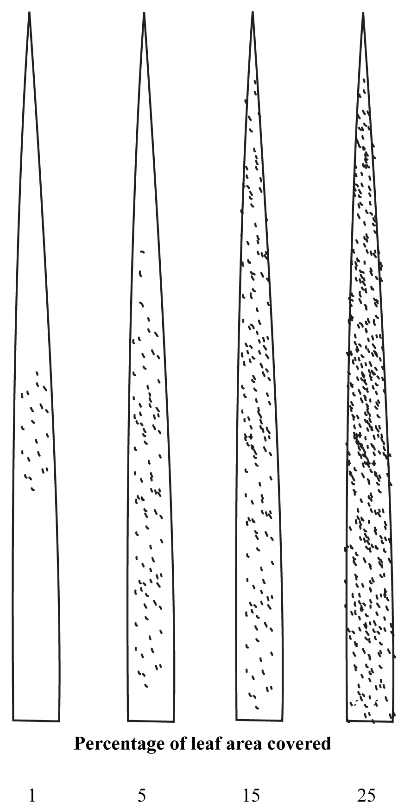


Fig 3.2
Percentage of leaf area affected by lef rust. (James, C. 1971. A Manual of Assessment Keys for Plant Diseases. Publication 1458. Canada Department of Agriculture.)

General Symptoms: Early infections appear as small yellow/orange spots on the foliage. Spots eventually develop into brown/orange raised pustules that will leave a brown/red rusty residue on fingers when pustules are rubbed between fingers. Leaf rust appears on the upper leaf surface and is generally brown in color. Stripe rust follows the leaf veins and is light orange in color.

Diagnosis: Easily identified with the naked eye in the field.

Description:
Puccinia recondita f.sp *tritici* (leaf rust) and *P. striiformis* f.sp *tritici* (stripe rust) occur frequently in the mid-Atlantic. These rusts may overwinter as mycelium in dormant wheat in the southernmost areas of the mid-Atlantic, particularly following a mild winter. More commonly, rusts blow in from the south and therefore arrive later in the growing season. Leaf rust does well under moderate temperatures (60-70°F) whereas stripe rust is favored by cool weather (50-60°F). Temperatures above 68°F inhibit stripe rust. Spores produced from pustules are wind distributed over large distances and are deposited by rain onto plants. When the environment is favorable, epidemics can develop rapidly and cause losses approaching 50% in susceptible varieties. Early season infections have the most impact on yield and can reduce root and tiller formation. Late season infections, which are common in many parts of the mid-Atlantic, are unlikely to cause significant yield reductions. New races of stripe rust have been identified that can better tolerate warm temperatures and ever-changing populations have overcome resistance in some varieties.

Management: Plant resistant varieties. Foliar fungicides applied before disease is present or reported in the area may be beneficial, particularly if a susceptible variety is planted. Avoid planting a variety in a subsequent year if stripe rust was detected in that variety the previous season.

Head Diseases

Glume Blotch

Scouting: Examine fields every week from Feekes 9 through Feekes 10.5. Scout at least 1 site per 10 acres of field. At each site observe plants within a 5-10 foot radius.

General Symptoms: Gray to brown spots form the chaff, typically starting on the upper ¾ of the glumes. Over time lesions can grow and brownish fungal structures form within gray centers of the lesion.

Diagnosis: Can be confused with other disorders such as bacterial diseases or chemical injury. Fungal structures are diagnostic but difficult to see without the aid of a hand lens.

Description:
Glume blotch is caused by *Stagonospora nodorum*, a component of Leaf Blotch Complex, which is described in the previous section.

Management: Plant resistant varieties. Varieties with resistance to Stagonospora leaf blotch may not be resistant to glume blotch and vice versa. Plant certified disease free seed and use recommended fungicide seed treatments. Destroy weeds and volunteer wheat or barley in fields prior to planting. Foliar fungicides applied before disease is present on the glumes may be beneficial if the environment is favorable for disease development.

Fusarium Head Blight

Scouting: Examine fields every week from Feekes' 10.5 to Feekes' 11. Scout at least 1 site per 10 acres of field. At each site observe plants within a 5-10 foot radius.

General Symptoms: Heads completely or partially bleached. Under humid conditions, masses or orange spores may be present at the base of infected kernels. Severely infected kernels may be shrunken, chalky, and shriveled. Infected heads may have elevated levels of deoxynivalenol (DON) a mycotoxin.

Diagnosis: Can be confused with other disorders such as insect injury, eyespot, or frost damage

Description:
Fusarium head blight (FHB) in the mid-Atlantic is caused predominantly by *Fusarium graminearum*. This is a reemerging disease that is likely to increase in incidence and severity due to widespread no-till and corn acres. This fungus overwinters in small grain or corn residue and produces spores under wet conditions (>70 % RH) and over a wide temperature range (60-85°F). Longer periods of wet weather are required for severe epidemics to occur under cool conditions. Approximately 70% of spores are ejected and carried long distances on wind currents and deposited at night. The remaining spores (30%), called macroconidia, are locally dispersed via rain splash. FHB only causes disease on heads and disease is most severe when appropriate conditions occur at or around flowering (Feekes' 10.5.1-yellow anthers observable at the center of heads). Once spores germinate, they can enter the head, resulting in kernel abortion and characteristic head bleaching. Depending on the environment, variety, and fungal strain, mycotoxins (DON and others) may be produced. Elevated levels of DON can result in dockage or rejection at the grain mill. Bleaching does not always indicate elevated DON levels in grain.

Table 3.13 Deoxynivalenol (DON) Advisory Levels Established by the FDA

Maximum Allowable DON Level (ppm)	Consumer
1	Humans
5	Swine and all animal species except cattle and poultry (Not to exceed 20% of the diet for swine and 40% for other animals
10	Ruminating beef and feedlot cattle older than 4 months and poultry (Not to exceed 50% of diet).

Management: Plant moderately resistant varieties with good tolerance to DON accumulation. DON management should be the focus when selecting a variety as DON levels do not correlate well with levels of bleaching, although bleached heads may indicate elevated levels of mycotoxins in a field. Research indicates that overall, the use of a locally adapted, moderately resistant variety can reduce DON by over 50% compared to susceptible varieties. Virginia Tech screens commercial and experimental wheat varieties for DON accumulation and growers should refer to these ratings when selecting a variety. The FHB fungus does not grow as well on soybean residue, so planting wheat after soybeans may help reduce local inoculum levels. Burial of residue through tillage may also help reduce local levels of inoculum. However, because the pathogen can be dispersed over long distances, local residue management may only have a minor effect on overall suppression of FHB and DON, particularly during severe epidemics. Staggering planting date may help reduce the likelihood that all fields will enter a susceptible stage when the environment favors FHB, although differences in flowering are likely to be subtle in warm environments. Several fungicides are available for suppression of FHB and DON. These products should be applied at least 10-15 gallons per acre at 35 psi with nozzles angled in a forward direction (30° optimal) if travelling above 10 mph in a ground rig. Aerial applicators should apply at 5 gallons per acre. The lowest labeled rate of a non-ionic surfactant may improve coverage of the head. Maximum product efficacy is obtained if fungicides are applied when plants have entered Feekes 10.5.1. Fungicides can be applied up to 6 days after the start of Feekes 10.5.1 without a notable drop-off in efficacy. Research trials indicate that currently, the best fungicides for suppression are Prosaro, Caramba and Proline. If applied properly these products reduce DON by approximately 45% compared to untreated controls. The use of moderately resistant varieties and recommended fungicides applied around Feekes 10.5.1 has been shown to reduce DON levels by 70% relative to untreated susceptible varieties in replicated national trials. The Fusarium Head Blight Prediction Center uses multiple sources of environmental weather data to determine the probability of FHB epidemics for wheat at a susceptible stage of growth (http://www.wheatscab.psu.edu/). This site can be used to help determine if a fungicide application is likely to be needed during the growing season. Remember, fungicide use alone is not likely to bring down DON levels to a manageable level if a susceptible variety is planted in an FHB-favorable year. Therefore, growers should integrate multiple practices to manage this disease.

Loose Smut

Scouting: Examine fields every week from Feekes' 10.5 until harvest. Scout at least 1 site per 10 acres of field. At each site observe plants within a 5-10 foot radius.

General Symptoms: Heads will contain a black/brown dusty mass of spores in the place of kernels and chaff. These spores eventually blow away, leaving a bare spike with a sooty appearance. Heads of infected tillers emerge from the boot earlier than healthy tillers and prior to heading diseased plants may appear darker than healthy plants.

Diagnosis: Easily identified in the field.

Description:
Loose smut is a disease that is infrequent in the mid-Atlantic, mostly as a result of seed treatment fungicides in wheat production systems. The disease is caused by the fungus, *Ustilago tritici* and yield losses can be significant in some situations. Spores of the fungus often enter the field on infested seed. After seed germination, the fungus grows within the plant without producing symptoms. When the head emerges the fungus invades the contents of the head, converting everything except the pericarp membrane and rachis to a mass of black fungal spores. Wind then disperses spores over long distances where they may land on flowering wheat or barley. Light rains and temperatures between 60 and 72°F favor germination of spores and infection. Once the fungus has established itself in the kernel it goes into dormancy. Infected seeds cannot be distinguished from infected seeds. The fungus only becomes active again when the infected kernel germinates.

Management: Plant certified disease-free seed. Utilize recommended seed treatment fungicides.

Other

Take-All

Scouting: Examine fields every other week from Feekes 5 through harvest. Scout at least 1 site per 10 acres of field. At each site observe plants within a 5-10 foot radius.

General Symptoms: Around head emergence leaves may become yellow and plants may be stunted or uneven. The most conspicuous symptom is premature white tillers. Take-all often occurs in patches but can also be uniform in distribution in some fields. The roots of infected plants will be brittle and rotten. If the outer leaf sheath is removed from the stem a shiny discoloration of the basal stem will be evident.

Diagnosis: Can be confused with other disorders such as head blight, sharp eyespot, frost injury, and insect damage. The shiny black appearance of the basal stem is diagnostic for the disease.

Description:

Take-all is caused by the fungus *Gaeumannomyces graminis*. This pathogen survives in fields on residue from infested small grains or grassy weeds. During the growing season, the fungus invades plant roots, compromising nutrient and water uptake. The pathogen is often most active in cool soils. Poorly drained soils, low soil fertility, and alkaline conditions may favor infection by *G. graminis*. Take-all is not often an issue due to the crop rotations that are commonly practiced in the mid-Atlantic.

Management: Rotation away from small grains for 2 years will reduce inoculum levels in the soil. Apply fertilizers and lime according to soil test recommendations. Minimize compaction and drainage issues.

On a related note, growers may have heard of a phenomenon known as, "Take-all decline." This has been observed in other regions where wheat monocultures are used extensively. In these cases, several years of wheat monoculture allows for the accumulation of antagonistic bacteria that compete with the pathogen for soil nutrients and resources.