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Field Crop Disease Management

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Field crop production practices continue to change as growers evaluate new techniques and technologies to increase productivity. Plant diseases, unfortunately, present a challenge to producers by continuing to limit yields in soybeans, corn, wheat, and alfalfa in Ohio. There are a multitude of crop production management decisions that producers must make throughout a growing season. Many of these decisions can influence the impact of plant diseases on yields. This bulletin describes many of the management options available for field crop producers in Ohio and how these management options influence crop disease development.

Proper cultural practices that favor the development of vigorous seedlings and hardy, mature plants will help manage diseases or lessen their detrimental effects. Disease management is also aided by good agronomic practices such as proper seeding rates and seeding dates, balanced fertility, crop rotation, tillage, and weed control. In other words, the healthier a plant is, the better able it is to still be productive, even in the presence of plant pathogens. Many disease-management decisions are made before planting. In most farming systems, the producer can do little once a disease becomes severe in his field. Therefore, prevention is the first, and usually the only, line of defense against disease. It is rarely economical to treat acreages with fungicides. The primary fungicide application method in field crops is seed treatment, where extremely low rates of active ingredient per acre are applied directly on the seed before planting in the soil.

Diseases are not mysterious things that occur for no reason. They are the direct result of three critical factors coming together at one time. Disease occurs when a pathogen attacks a susceptible plant under environmental conditions that favor the infection and growth of the pathogen within the plant. The most common disease-causing agents, or pathogens, are fungi, bacteria, viruses, and nematodes. The most critical environmental factors are soil and air temperature, moisture as rain or dew, relative humidity, soil fertility, and pH. Serious disease can occur on susceptible cultivars when environmental conditions are right for the spread of an aggressive pathogen. For instance, the fungus that causes leaf rust of wheat produces severe yield losses on susceptible varieties when spores are blown in on wind currents from the southern states. Infection and rapid spread occurs in late May or early June when the day and night temperatures are between 60°F and 72°F and at least six hours of leaf wetness occurs for several days each week. Susceptible varieties may have as much as a 50 percent yield loss, whereas resistant varieties may have little or no yield loss.

The cornerstone to successful disease control is correct identification of the disease problems on your farm. Producers facing specific disease problems can fine-tune their disease-control strategies to those few diseases encountered each year. Those with little experience identifying diseases should seek help from competent sources. Disease samples can be submitted to the C. Wayne Ellett Plant and Pest Diagnostic Clinic for diagnosis at The Ohio State University. Clinic forms and information on proper packaging of plant material can be obtained from county Extension offices. Submit plant samples to the following address:

C. Wayne Ellett Plant & Pest Diagnostic Clinic
The Ohio State University
Room 110, Kottman Hall
2021 Coffey Rd.
Columbus, OH 43210

Table 1. Comprehensive Disease Control Program for Field Crops

1. **Select** varieties and hybrids resistant to the most common or economically important diseases in specific fields. Resistant varieties with yield potential, good agronomic characteristics, and excellent quality are available for most field crops. Refer to Ohio State University Extension performance trial evaluations for resistance ratings of specific crops.

2. **Plant** only the highest quality, disease-free seed. Be sure that the seed is well-cleaned, has a high germination percentage, and is guaranteed to be genetically pure to the variety or hybrid stated on the label. Where appropriate, use seed-treatment fungicides to control diseases. See OSU Extension Bulletin 639, *Seed Treatment for Agronomic Crops;* and 639A, *Efficacy of Seed Treatment Fungicides for Agronomic Crops in Ohio* for specific crop recommendations for seed-borne and soil-borne diseases of concern.

3. **Plant** when soil temperature and moisture are most favorable for specific crop seed germination and seedling growth of the crop planted. Planting in roughly prepared soil, under conditions which are too cold or warm, or too wet or dry increases the chance of seed-rot and seedling-blight diseases. Seed treatment fungicides will often help stand establishment when seeds are planted under environmental conditions that favor pathogens.

4. **Follow** a good crop-rotation sequence. Avoid planting the same crop in a field year after year, since monoculture promotes build up of pathogen populations. Always alternate to non-host crops in the rotation sequence and provide sufficient time between susceptible crops for the population of disease organisms to decline.

5. **Destroy** residues of the previous crop by tilling as far in advance of planting the new crop as possible. Many disease organisms that survive from year to year on crop residues can be eliminated by incorporating the residue into the soil. Farmers using reduced tillage systems need to pay particular attention to using adequate crop rotations.

6. **Plan** a well balanced soil fertility program based on a soil test. Proper soil pH and adequate amounts of nitrogen, potassium, and phosphorus in proportions required by the crop species will promote healthy plant growth. Avoid high salt accumulation from excessive manure or organic-waste applications. Maintain as high a soil-organic matter content as economically feasible.

7. **Control** weeds that compete with crop plants for nutrients and moisture. Weeds can serve as alternate hosts for pathogens thus increasing pathogen populations. Weed may also result in higher humidity within the plant stand, favoring disease development.

8. **Maintain** plant vigor by controlling insects. Insects may transmit virus or bacterial diseases or injure plants providing entry points for pathogens. Insect feeding injury can also reduce plant vigor.

This Extension bulletin outlines the most effective control procedures for the major field-crop diseases. No attempt is made to cover all diseases or to present detailed information on disease cycles or symptoms. Several recent Extension publications provide color photos of the major diseases and complete descriptions of factors affecting their development. These publications are available from your local Extension office. Ohio State University Extensions' web site *Ohioline* (http://ohioline.ag.ohio-state.edu) provides up-to date resources on diseases in the form of fact sheets, bulletins, and newsletters.

Although not all diseases are described in this bulletin, the management practice summaries following each crop section provide comprehensive disease management strategies for specific crops. To achieve adequate disease control, producers should follow a comprehensive disease-management program. Most of these disease-management procedures are also excellent agronomic practices. The major disease-control practices to be followed for most field crops are listed with Table 1. Specific control procedures are outlined in each crop section.

Corn Diseases

The major corn diseases can be grouped into four categories: leaf blights, stalk rots, ear rots, and viral diseases.

Leaf Blights: A number of leaf-blight diseases occur on corn. The most common are gray leaf spot, Stewart's bacterial leaf blight, and northern corn leaf blight. These diseases can be found in almost any field, depending on the year and susceptibility of the hybrid planted. Some leaf-blight diseases are most often found associated with continuous corn, especially in reduced-tillage, continuous corn fields. These are anthracnose, gray leaf spot, eyespot, and northern leaf spot.

All leaf blight diseases cause loss of green leaf tissue, resulting in fewer kernels and lightweight grain. Plants may be predisposed to stalk-rot diseases when leaf damage is severe. The amount of yield loss is usually related to the time when the plant's upper leaves become infected. The most severe yield loss occurs when the upper leaves, the ear leaf, and those above the ear, become infected at or soon after tasseling. Yield losses will be minimal if disease does not occur on these leaves until six to eight weeks after tasseling.

Leaf blight diseases are most effectively controlled by selecting hybrids with genetic resistance. Contact your seed dealer for information on hybrids with resistance to gray leaf spot, Stewart's bacterial leaf blight and other leaf diseases important in your area. A one-to two-year rotation away from corn and destruction of old corn residues by tillage may be helpful if susceptible hybrids must be grown. Fungicides are also available for control of leaf diseases, but are economically viable only under severe disease pressure.

Stalk Rot: Stalk rots are the most important and common diseases of corn. Annual losses are estimated at 5 to 10 percent. There are several stalk-rot diseases, but Gibberella stalk rot and anthracnose stalk rot currently are the most prevalent. Both are fungal diseases that result in premature ripening, chaffy ears, and lodging of plants before harvest. The interior of the stalk becomes rotted, tissues break down, and the stalk is easily broken. Anthracnose stalk rot is usually associated with continuous corn and is recognized by the blackening of the outer surface of the stalk late in the season. Stalks with Gibberella stalk rot can be found in nearly any field. Affected stalks often have pink to reddish discolored internal tissues. Control of stalk rot diseases is based on reducing plant stress from factors such as lack of moisture, leaf diseases, insect injury, and nutritional stress. To reduce the affects of stalk rot diseases, follow as many of the following practices as possible:

1. Select hybrids with good standability and resistance to leaf blight diseases.
2. Adjust soil fertility to recommendations based on a soil test. Avoid excessive rates of nitrogen in relation to potassium.
3. Follow a one- to three-year rotation away from corn. Soybeans, forage legumes, and small grains are acceptable in the rotation. The longer the rotation away from corn the better.
4. Plant at populations recommended for the hybrid grown. Overplanting leads to increased moisture, light and nutrient competition, and more plant stress.
5. Harvest fields with the greatest level of rotted stalks first to avoid lost ears on lodged plants.
6. Control insects, particularly root worms and stalk borer. Insects cause injuries to plant roots and stalks permitting stalk rot fungi to enter the plant. See Ohio State University Extension Bulletin 545 *Insect Pests of Field Crops* for insect control recommendations.

Ear Rot: Gibberella, Fusarium, and Diplodia ear rot diseases occur in Ohio, but Gibberella ear rot is the most important. The Gibberella ear rot fungus is the same fungus that causes Gibberella stalk-rot disease. *Gibberella* enters from the silk end of the ear when cool, wet weather persists for several weeks through late silking of the crop. The occurrence of a whitish to pinkish mold on the ear tip is diagnostic, but extensive mold growth may not occur. On shelled grain, the symptoms may be seen as a pinkish coloration in some of the kernels. Even though extensive rotting does not always occur, the disease is serious because the fungus frequently produces toxins that makes the corn unfit for feeding. Hogs are particularly sensitive to the toxins produced in moldy grain and may refuse to eat it even when hungry. If hogs refuse to eat grain, have a mycotoxin analysis run to determine the kinds and levels of toxin present. Some corn hybrids are less susceptible than others to Gibberella ear rot. Ears with tight husks which mature in an upright position often have more ear rot than those maturing in a declined position. Diplodia ear rot appears to be more common in continuous corn under reduced tillage. Ears affected by *Diplodia* are covered with a thick mat of white fungal growth. Fusarium ear rot is common, but only individual kernels are affected on ears. Plant hybrids known to be less susceptible to these ear diseases. Grain with evidence of ear or kernel rot should be dried to 14 percent moisture before storage and maintained at this level until used. Feeding less than 5 percent moldy kernels may prevent feeding problems, but grain should be tested for mycotoxin levels prior to feeding to avoid any problems. For more information on mycotoxins, refer to Ohio State University Extension Bulletin 735 *Moldy Grains, Mycotoxins, and Feeding Problems* or contact Ohio State's Plant and Pest Diagnostic Clinic.

Virus Diseases: Maize dwarf mosaic and maize chlorotic dwarf, are potentially destructive diseases where johnsongrass is established. The two viruses that cause these diseases are able to survive in this perennial weed grass. Aphids and leafhoppers feeding on johnsongrass in the spring pick up the virus and inoculate nearby corn. Control is achieved by planting resistant or tolerant hybrids. Efforts also should be made to eradicate johnsongrass.

Management Practices for Corn Diseases

1. Select corn hybrids with resistance to northern corn leaf blight and Stewart's bacterial leaf blight. Some hybrids are now available with moderate levels of resistance to gray leaf spot. In areas infested with johnsongrass, corn hybrids with resistance to virus diseases also may be necessary. Corn hybrids with resistance to stalk rot, ear rot, and other leaf diseases also are available. Contact your seed dealer for details.
2. Plant only high-quality seed with a high germination percentage. Plant in a well-prepared seed bed when the soil temperature is 55°F or above and moisture level is sufficient for rapid germination and growth of seedlings. Most seed corn is treated with a fungicide by the seed producer to control seedling diseases. Seed treatment is particularly important when planted early in cool, wet soils.
3. Cultural practices such as crop rotation and tillage are important disease-control methods. Corn should be rotated with legume and/or small grain crops. If no tillage is used, a two-year period away from corn is recommended, but a one-year rotation away from corn may be sufficient if residues are destroyed by tillage.
4. To ensure good growth and acceptable yields, provide adequate fertility based on a soil test. Plan a balanced fertility program, avoiding excessive rates of nitrogen or other nutrients. Replace nutrient levels as required by amounts harvested in plant products.
5. Control insects and weeds. See Ohio State University Extension Bulletins 545, *Insect Pests of Field Crops* and 789, *Weed Control for Ohio Field Crops* for specific control methods.
6. Harvest promptly when corn matures to 23 percent moisture for shelled and 25 percent moisture for ear corn. For long-term storage, ear corn should be 20 percent moisture or less, and shelled corn should be 14 percent moisture.

Additional information on corn disease and their control is in Ohio State University Extension Bulletin 802, *Corn Disease Control in Ohio*, available from your local county Extension office or the Ohio State University Extension website *Ohioline* (http://ohioline.ag.ohio-state.edu).

Soybean Diseases

The major soybean diseases can be classified as root rots, stem rots, leaf blights, and seed diseases.

Root Rots: Several root and lower-stem rot diseases are frequently encountered. These diseases are caused

by fungi that live in the soil and parasitize the lower portion of the soybean plant. The two most common are Phytophthora root rot and Rhizoctonia root rot. Phytophthora root rot is the most destructive. Thousands of acres of soybeans are destroyed by this disease each year. The *Phytophthora* fungus attacks plants at any stage of growth, from germinating seedlings through mature plants. Infected plants generally wilt and die soon after infection or are stunted. Phytophthora root rot occurs most frequently in heavy soils with poor drainage or in years with high rainfall. Fungal populations are comprised of a number of races that attack varieties with different genes for resistance. Rhizoctonia root rot is generally more prevalent in years when weather conditions are dry in early spring and then turn wet; however the disease can occur under other conditions, as well. *Rhizoctonia* attacks the base of the plant at the soil line causing reddish-brown cankers on the lower stem. Charcoal rot has occurred in Ohio in years with high temperatures during pod-filling. Temperatures at 85 to 95°F for extended periods favors disease development as does drought stress. Symptoms include stunting, yellowing of leaves, discolored root tissues, and premature death. Diagnosis of charcoal rot is based on characteristic black zoning or charcoal-colored speckling within root tissues. There are no adequate management methods for Rhizoctonia root rot and no resistant varieties are available for charcoal rot. Adequate fertility, a three-year crop rotation including small grains or corn may help in reducing losses.

Phytophthora root rot can be controlled with resistant soybean varieties. However, a number of different races occur, so previously resistant varieties may be susceptible to new races that develop within fields. Varieties with a high level of partial resistance are also available. These varieties are susceptible to infection, but do not have the excessive yield loss associated with susceptible varieties. A listing of varieties with specific Rps resistance genes to the prevalent races of *Phytophthora* and ratings for the level of partial resistance to the disease are provided in the current edition of *Ohio Soybean Performance Trials*, Horticulture & Crop Science, Series 212, available from your local county Extension office. Performance of resistant and partial resistant varieties can be improved by treating seed with fungicides that control *Phytophthora*. Losses also can be reduced by using some form of tillage and providing adequate subsoil and surface drainage to problem fields.

Stem Rots: The symptoms of most stem rots develop two to three weeks prior to maturity and often are misdiagnosed as early maturing beans. Cool, wet weather conditions in midsummer favor development of Sclerotinia white mold, brown stem rot, and Diaporthe stem rot which are all found in Ohio. Hot, dry summer conditions promote the development of charcoal rot. Sclerotinia white mold is the most common of the stem rot diseases and has been increasing in incidence in Ohio. This disease has a characteristic fluffy white mold growth that develops on the nodes and stems. The white mold continues to grow and causes a girdling lesion on the stem. The leaves wilt and turn brown, affected plants die, but remain erect in the field. These dead plants with wilted leaves can be spotted in fields during mid- to late August and can be confused with brown stem rot. Black, hard sclerotia (resistant fungal bodies) develop both inside and outside the stems and within the pods. These sclerotia are harvested with the beans and can be collected with seed by combines, returned back to the soil with the debris, or carried from field to field on harvesting equipment. Management of this disease is first dependent upon preventing introduction into a field. Plant only well-cleaned seed and treat seed with a fungicide effective against *Sclerotinia*. Some varieties do appear to be less susceptible to this pathogen by having less disease by the end of the season. It will be difficult to reduce the level of *Sclerotinia* in fields with high disease severities, but long crop rotations with corn, wheat, and/or alfalfa and selecting varieties that are less susceptible should improve the productivity of affected fields.

Leaf Diseases: Several leaf diseases of soybean are common every year, but they seldom destroy enough leaf tissue to reduce yields. One of these diseases, Septoria brown spot, usually develops on the lowest leaves in late June and early July and results in a conspicuous yellowing followed by leaf-drop. This disease is worse during wet weather and may reappear in late summer during wet, cooler weather and cause premature leaf yellowing and leaf-fall. Bacterial leaf blight occurs on leaves at various levels on the soybean plant, depending on the stage of growth in relation to the rain periods favoring disease establishment. The blighted areas of the leaves frequently drop out or tear away giving a ragged appearance to the foliage. Downy mildew causes yellow spots on the upper sides of the leaves and grayish tufts of mold growth on the lower surfaces

of leaves. Because very little or no yield loss results from the occurrence of these diseases, no control methods are recommended. Most varieties appear susceptible to these leaf diseases and continuous cropping to soybean may increase their severity.

Seed Diseases: Moldy seed at harvest results from one or more damaging diseases of soybean caused by *Phomopsis* and *Diaporthe* fungi. Phomopsis seed decay is most serious when wet conditions prevail late in the season as the seeds mature and before they dry down to a moisture level suitable for combining. Soybeans left in the field because of delayed harvest due to wet weather are almost sure to develop *Phomopsis* infections. Moldy seed results from fungal invasion of pods and seeds. The most important aspect of Phomopsis seed decay is the effect it has on seed germination. Moldy seed will not germinate or seedlings die before emergence. Seeds that look healthy may often have seed coats colonized by *Phomopsis*. These fungi will grow into the germinating seed and kill the seedlings before emergence. The level of infected seeds can be determined by a standard germination test.

Producers interested in growing their own soybean seed should be particularly aware of the problems associated with Phomopsis seed decay. Producers should avoid growing continuous soybean and harvest those fields to be saved for seed first. Before planting, all seed should be evaluated using a standard germination test. Use only those seed lots with 80 percent or greater germination. On those lots with 80 to 90 percent germination, adjust the seeding rate to compensate for the lower germination percentage, and plant only if adequate soil moisture is available for rapid germination. Most fungicide seed treatments available for use on soybean control *Phomopsis*. However, growers should not expect to increase germination of diseased seed lots by more than 20 percent.

Soybean cyst nematode: Soybean cyst nematode (SCN) can be found at some level in most of the soybean producing counties of the state. Frequently no visible symptoms of nematode damage are observed other than reduced yield. Visible symptoms of SCN damage includes stunted, yellow plants and weed infestations where diseased soybeans lack adequate growth. SCN is a microscopic round worm that exists in soil as eggs, worms, and cysts. Soils with moderate to high levels of nematodes (250 to 2,000 eggs/200 cc of soil) should implement control measures to reduce nematode populations and reduce yield losses. The only definite way to confirm the presence of SCN, or determine the level of infestation, is to submit soil samples for laboratory analysis. Contact Ohio State University Extension's C. Wayne Ellett Plant and Pest Diagnostic Clinic for proper soil sampling procedures and information concerning soil analysis. The soybean cyst exists in various races that are capable of attacking different soybean varieties. Resistant varieties are available, but they should never be planted year after year in the same field or in fields with very high levels (greater than 2000 eggs/200 cc soil) of the nematode. A two to three year rotation with alfalfa, corn and small grains can be used to reduce nematode populations and rotating resistant and susceptible soybean varieties in the rotation will help keep the populations low. Maintaining a balanced fertility program and planting early when soils are cooler and the nematode is less active will help reduce losses from SCN.

Management Practices for Soybean Disease Control

Disease Control

1. Select varieties with specific resistance or partial resistance to Phytophthora root rot, or varieties less susceptible to Sclerotinia stem rot, if these diseases have caused reduced yields on your fields. Use soybean cyst nematode resistant varieties in fields with soybean cyst nematodes, but only if used in a crop rotation sequence designed to reduce nematode populations.
2. Plant only well cleaned, high quality, disease-free seed with a germination of 80 percent or greater. Treat seed with *Phytophthora* specific fungicides if seeds will be planted in a field with a history of Phytophthora root rot. Plant only if adequate soil moisture is available for rapid germination. Also treat seed with an appropriate fungicide if *Phomopsis* or *Sclerotinia* were known to be present in seed production fields. For seed-treatment recommendations, refer to Ohio State University Extension Bulletin 639, *Seed Treatments for Agronomic Crops*.
3. Improve surface and subsurface drainage to remove excess water quickly. This will reduce damage caused by *Phytophthora* and Pythium damping off.
4. Rotate soybean with corn or small grains; a two- to three-year rotation is adequate under most circumstances. Up to five years may be necessary to reduce population of *Sclerotinia* or at least three years for

high populations of soybean cyst nematode.

5. Incorporate residues if severe disease problems occur from leaf diseases and brown stem rot. Tillage will improve surface drainage and reduce damage from Phytophthora root rot.
6. Weed control is especially important because weeds act as hosts for Sclerotinia white mold and soybean cyst nematode.
7. Harvest as quickly as possible to avoid moldy seed caused by *Phomopsis*.

Additional information on soybean diseases and their control is provided in Ohio State University Extension Bulletin 741, *The Soybean in Ohio* available from your local county Extension office or on the Ohio State University Extension Website *Ohioline*. (http://ohioline.ag.ohio-state.edu).

Wheat Diseases

Many different types of diseases affect wheat. They can be classified as seed-borne diseases, leaf and head blight diseases, crown and root rot diseases, and virus diseases.

Seed-Borne Diseases: Most problems resulting from seed-borne diseases have been eliminated by highly effective seed-treatment fungicides. Several seed-borne diseases are of concern to wheat growers. They are seed-borne scab, seed-borne *Stagonospora* (previously known as *Septoria*), common bunt (stinking smut), and loose smut. Seed-borne scab and *Stagonospora* are discussed later in the section on leaf and head blight diseases. Both diseases result in lightweight, shriveled kernels that may be moldy. Producers should follow the recommendations listed below for proper seed cleaning and planting to reduce seedling blight and stand losses resulting from planting diseased seed.

The two smut diseases, stinking smut and loose smut, can be particularly devastating. Stinking smut causes losses by giving the seed of diseased plants a foul, fishy odor, making the grain unfit for milling. Producers have been docked severely when attempting to sell smutty grain. Loose smut affects plants and yield by converting the grain and parts of the head to smut spores. Therefore, infected plants have no grain left to harvest. There are no varieties resistant to stinking smut, and numerous races of the loose smut fungus exist.

Note the following guidelines to control seed-borne diseases and seedling blights:

1. Plant the highest-quality, disease-free seed possible. Seed-production fields should be inspected from the head-emergence growth stage through harvest for occurrence of scab, Stagonospora glume blotch, loose smut, and stinking smut. Do not use seed from severe smut infested fields.
2. Clean seed thoroughly to remove all shriveled, lightweight kernels. This may require raising the test weight of the grain by several pounds per bushel.
3. Have a standard germination test run on the seed. Use only seed with 80 percent or greater germination percentage. If poor germination is due to Fusarium head scab, certain seed treatment fungicides can improve germination by 15 to 20 percent.
4. All wheat seed should be treated with a seed-treatment fungicide effective for control of smut fungi, Fusarium scab and *Stagonospora*. More information on seed-borne and soilborne diseases and seed treatment fungicides is available in Ohio State Extension Bulletin 639, *Seed Treatments for Agronomic Crops*, available at your local county Extension office.
5. Plant in a well-prepared seed bed or with a no-till drill capable of proper seed placement, when soil moisture is adequate and soil temperatures are not too high. Plant after the Hessian fly safe date for your county to help avoid seedling diseases.

Leaf- and Head- Blight Diseases: Major diseases in this group are powdery mildew, leaf rust, Septoria tritici leaf blotch, Stagonospora (Septoria) nodorum leaf and glume blotch, and Fusarium head scab. All can cause major yield losses, but their occurrence is essentially weather-dependent. Cool, rainy weather from mid-April through the flowering period of the wheat plant in late May to early June favors the development of most of these diseases. They require either the leaf surfaces to be wet for a certain period of time or the relative humidity within the plant canopy to be near 100 percent. Powdery mildew and Septoria tritici leaf blotch are the first leaf diseases to occur in the spring. Both are favored by cool, humid, or wet weather. Leaf rust and Stagonospora nodorum leaf blotch require slightly warmer weather, thus they follow in mid to late May. Stagonospora nodorum glume blotch and Fusarium head scab become evident in June soon after flowering, especially if wet weather persists through this time.

The use of resistant varieties is the major control

procedure for these leaf and head blight diseases. Few varieties are resistant to all of these diseases. Determine which diseases cause most consistent problems in your area, and choose a variety based on its level of resistance. The level of fungal carryover from one wheat crop to the next is minimal if a two-to three-year rotation away from wheat is maintained. Rotation is a primary control measure for powdery mildew and the *Septoria* and *Stagonospora* diseases. Spores of leaf rust are blown up from the southern states in late May; therefore, crop rotation has little effect on the incidence of leaf rust. Adequate and balanced fertility, to provide optimum nutrition for hardy plants, helps lessen the adverse effects of foliage diseases. High rates of nitrogen will favor powdery mildew and Stagonospora leaf and glume blotch. Head scab is usually more severe when wheat is planted after corn because the fungus causing scab is the same one that causes Gibberella stalk rot. When possible, wheat should follow soybean or other legumes in the cropping sequence.

Fungicides are available to control most foliar diseases of wheat. However, the use of these fungicides should be based on sound economic decisions and the level of disease in the field. Fungicides have been profitable during years when foliar diseases have been severe on susceptible cultivars or in locations where diseases are a persistent problem. Obtain a copy of Extension Bulletin 735, *Wheat Disease Control in Ohio* or contact your local county Extension office for up-to-date information on fungicide recommendations for wheat or consult the Ohio State University Extension Website *Ohioline* (http://ohioline.ag.ohio-state.edu).

Crown and Root Rot Diseases: Two of the more important crown- and root-rot diseases are take-all and Cephalosporium stripe. Both of these diseases are soilborne, meaning that the fungi that cause these diseases reside in the soil. Take-all can be recognized by examining the roots and lower stems of prematurely killed plants. The base of the stem and roots will have a scurfy, black appearance. Cephalosporium stripe disease is characterized by alternating yellow and brown stripes that extend the entire length of the leaf blades. Both of these diseases are favored by planting wheat year after year in the same field. Usually a rotation sequence with a break of two years or more between wheat crops will eliminate fungal carryover. The exception to this is when no-till is used to produce all crops in the rotation sequence and wheat residues do not decompose before the next wheat crop is planted. The other exception to this is when perennial grass weeds, such as quack grass, become established in the field. Proper rotations, tillage and elimination of grass weeds have been highly effective in managing both diseases. Additional control of the stripe disease can be achieved by maintaining a soil pH above 6.2 by proper liming according to a soil test. Adequate soil fertility will also reduce yield losses from root diseases.

Virus Diseases: Wheat spindle streak mosaic (yellow mosaic) and barley yellow dwarf are the two most common virus diseases. Wheat spindle streak mosaic is a soilborne disease that is usually recognized in early May as the stems of the wheat plant begin to elongate. The upper leaves of affected plants will show short, spindle-shaped, yellow streaks. These symptoms may intensify if weather remains cool. The symptoms will tend to disappear as the weather begins to warm. Control of wheat spindle streak is achieved through the use of resistant varieties. A number of highly-resistant varieties are available.

Barley yellow dwarf virus is transmitted by aphids. Aphids arriving from the southern states transmit the virus to the newly-planted wheat crop in the fall. Severely affected plants may be stunted, have reddish or yellowish leaf tips and produce no heads. Yield losses greater than 50 percent have occurred when entire fields have been infected in the fall. Because no varieties have an acceptable level of resistance and early-fall infections cause the greatest yield losses, wheat planting should be delayed until after the Hessian fly safe date when aphids have ended their fall flights.

Wheat Disease Management Summary

1. Choose varieties resistant to the major foliar diseases in your area. Varieties with resistance to wheat spindle streak mosaic, leaf rust, powdery mildew, Stagonospora leaf and glume blotch, and head scab are available. Information on the level of disease resistance in the more common varieties is available from seed dealers or local county Extension offices.
2. Plant only well-cleaned, disease-free seed that has a high-germination percentage. All seed should be treated with a fungicide to manage stinking smut or loose smut, as well as seed-borne Fusarium scab and *Stagonospora*. Consult Extension Bulletin 639 *Seed treatment for Agronomic Crops* for specific recommendations.
3. Plant in a well-prepared seed bed or with a no-till drill capable of proper seed placement, after the

Hessian fly safe date for your county. Plant only if soil temperature and moisture is adequate for rapid germination and seedling growth.

4. Use a crop rotation with a minimum of two years between wheat crops. Rotations with legumes are particularly helpful in reducing the survival of pathogens in the field. Where possible, do not plant wheat after corn due to the increased potential of Fusarium head scab.
5. Till residues in heavily-diseased fields, especially those affected by Cephalosporium stripe or take-all. Burying will enhance decomposition of residues and death of the disease-causing fungi.
6. Use a well-balanced fertility program and maintain a soil pH from 6.2 to 6.7. Be sure sufficient nitrogen, potassium, and phosphorus are available for good seedling growth in the fall. Excessive nitrogen may increase losses from foliage diseases.
7. Control grass weeds. Destroy volunteer wheat, quackgrass, and other weed grasses to reduce the amount of certain pathogens surviving in and around fields.
8. Harvest promptly when grain moisture permits. Store grain at moisture levels no higher than 13 percent, thus preventing storage molds from growing.
9. Fungicides are available for control of many foliar wheat diseases. Use of fungicides is dependent on susceptibility of the variety, level of disease in the field, the yield potential of the field and the price of grain. Specific recommendations for use of fungicides are available in Extension Bulletin 735, *Wheat Disease Control in Ohio* or in Bulletin 811, *Profitable Wheat Management*, or on Ohio State University Extension Website *Ohioline* (http://ohioline.ag.ohio-state.edu).

Oat Diseases

In the past, oat diseases have resulted in considerable yield losses. Many of these diseases are no longer important since the development of resistant varieties. Diseases that have caused problems in recent years include loose smut, covered smut, and barley yellow dwarf virus.

Several new resistant varieties are available for control of barley yellow dwarf virus (See virus diseases in the wheat section). Only seed guaranteed to be free of the smut diseases or seed treated with a fungicide to control smut diseases should be planted.

Oat Disease Management Summary

1. Choose varieties with resistance to barley yellow dwarf.
2. Plant only well-cleaned, disease-free seed treated with a fungicide seed treatment for smut diseases.
3. Plant as early in the spring as the soil conditions permit. (March to early April).
4. Rotate oat crops with other grain and forage crops. A two- to three-year rotation is sufficient.

Alfalfa Diseases

There are more than a dozen diseases of alfalfa. They can be grouped into two categories: those that affect the stems, crowns, or roots and those affecting the foliage. The stem and root-rot diseases are the most serious. Major losses of stand have been caused by Phytophthora root rot, anthracnose, and Sclerotinia crown rot. Verticillium wilt is a constant threat because some farmers are still growing old varieties that lack resistance to this disease. Nearly all alfalfa varieties currently grown in Ohio have resistance to bacterial wilt and Fusarium wilt. The widespread use of resistant varieties has greatly diminished the significance of wilt diseases.

Phytophthora root rot has been responsible for loss of stand in the seedling year when rainfall is above average and/or surface and subsurface drainage is poor. It is caused by a soilborne fungus that becomes active under wet soil conditions and may attack both seedlings and older plants. Dark brown, decayed areas on the tap root two to three inches below the soil surface are early indicators of Phytophthora root rot. Soil moisture is the key factor affecting disease development. Any improvement in surface and subsurface drainage will reduce losses from this disease as well as from other less common root rots. Varieties with good levels of resistance are now available. *Phytophthora* specific fungicide seed treatments are available to help prevent loss of stands due to seedling damping-off. Fungicides are labeled for use at planting either as a broadcast application or incorporated on fertilizer granules and applied in a band beneath the seed.

Aphanomyces root rot may contribute to poor alfalfa establishment and reduced growth in wet soils. Seedlings may die (damping off) if infection occurs at an early stage of development. Older seedlings are yellowed and stunted. When *Aphanomyces* and *Phytophthora* occur together, they form a destructive disease complex. Alfalfa varieties with moderate to good levels of resistance are available for control of Aphanomyces root rot.

Anthracnose is a major cause of thinning of older alfalfa stands. Seedlings may be killed or crown and crown buds of older plants may be affected. Wilted and dead bleached stems are characteristic of the disease. Diamond-shaped lesions (cankers) with light-brown centers and dark margins develop on the lower stems. Anthracnose is a warm, wet-weather disease. Resistant varieties are available. Anthracnose has long been recognized as a destructive disease of red clover in the southern areas. The use of resistant varieties of red clover controls this problem.

Sclerotinia crown rot occurs almost exclusively on late-summer seedings, especially when minimum-tillage methods are used. Affected plants wilt and the cottony-white mold changes to hard black bodies on the crowns or lower stems. This disease is usually seen during the cooler periods of the year. Crop rotation, with two to three years away from alfalfa, aids in control.

Verticillium wilt may be spread from field to field with infested seed and in manure from animals fed infested hay. This soilborne disease usually does not become a problem until the third production year. It can be recognized on scattered plants that become yellow and stunted, then gradually die, leaving a thin, unproductive stand. Control is mainly through use of disease-free seed, resistant varieties, and crop rotation.

There are several foliage diseases of alfalfa. Any of these may cause considerable loss of leaves during periods of prolonged wet or humid weather. Little can be done about these diseases in the year that they occur. Proper crop rotation will help control these diseases in following years.

Alfalfa Disease Management Survey

1. Select high-yielding, winter-hardy varieties with resistance to Phytophthora root rot, anthracnose, Verticillium wilt and Aphanomyces root rot. Consult The OSU Horticulture and Crop Science Series 195, *Ohio Forage Performance Trials* for a listing of alfalfa varieties and their level of resistance to various diseases.
2. Use seed-treatment fungicides specific for *Phytophthora* and *Pythium* to reduce losses from damping off. Most high-quality varieties now come pretreated with fungicides.
3. Select well-drained fields. If necessary improve soil drainage to prevent excess moisture accumulation for extended periods of time.
4. Fertilize to obtain adequate levels of nutrients for amount of forage harvested.
5. Maintain a soil pH near 7 to avoid low pH stress.
6. Plant in a well-prepared seed bed when soil moisture is adequate for quick germination and seedling emergence. For late summer, no-till seeding, plant as early in August as possible to avoid seedling losses due to Sclerotinia crown and stem rot.
7. Minimize traffic over the field. Crown damage from heavy equipment provides an entry way for pathogens as well as causing soil compaction which promotes root rots.
8. Harvest on time. Proper harvest intervals will ensure adequate storage of reserves in taproots while minimizing the buildup of disease organisms on leaves, stems and crowns.
9. Control insects, primarily alfalfa weevil and potato leafhopper, to minimize plant stress. See Extension Bulletin 545 *Insect Pests of Field Crops* for insect control recommendations.
10. Rotate to corn or small grain between alfalfa crops. Never follow alfalfa with alfalfa.

Other Field Crop Disease Management Publications

More detailed information concerning specific agronomic crop diseases can be found in fact sheets on *Ohioline*.

The following publications are available from Ohio State University Extension through county offices.

Corn Disease Control in Ohio, Extension Bulletin 802

Moldy Grains, Mycotoxins, and Feed Problems, Extension Bulletin 735

Profitable Wheat Management, Extension Bulletin 811

Seed Treatment for Agronomic Crops, Extension Bulletin 639

The Soybean in Ohio, Extension Bulletin 741

Wheat Disease Control in Ohio, Extension Bulletin 735

Ohio Forage Performance trials, OSU Horticulture and Crop Science Series 195

Ohio Corn and Soybean Performance Trials, OSU Horticulure and Crop Science, Series 212 and Series 215

Ohio Wheat Performance Test, OSU Horticulure and Crop Science, Series 228

Ohioline, Extension Website site at:
http://ohioline.ag.ohio-state.edu

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