Introduction

Diseases are just one factor that may produce spots and other symptoms on barley. They may be caused by the genetics of the cultivar, the environment, agricultural chemicals or even nutrient deficiencies.

Determining the cause of any severe symptoms is important because a disease may lead to economic losses, but could be prevented or treated.

Different solutions are needed for chemical injury or nutrient deficiencies.
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Parts of the Barley Plant

- Flag leaf
- Spike or Head
- Stem
- Leaf
- Node

- Crown
- Crown roots
- Subcrown internode
- Seed
- Seminal roots
Parts of the Barley Spike

- Node
- Rachis
- Glumes
- Caryopsis (seed)
- Awns

2-rowed barley

6-rowed barley

Barley Disease Handbook, Neate, S. and McMullen, M., North Dakota State University, 2005
Leaf, Stem and Head Diseases

DIAGNOSIS

Diagnosing a disease in a crop from a vehicle is impossible.

Stunting or color changes in the crop indicate a need to inspect at close range, but by the time these gross changes are obvious, it may be too late to control the disease.

You must walk into the crop and inspect the plant from the crown to uppermost leaves, as many diseases only develop on specific plant parts.
DIAGNOSIS

Root and crown diseases are generally hidden because the symptoms are underground or at the soil surface. Often the only visible symptoms are poor crop growth or stunting. In some cases there is a brief period where obvious top symptoms, such as bleached heads or premature death of the plant, occur shortly before the crop ripens.

To diagnose root and crown diseases you need a digging implement, a small knife and a bucket with water or access to running water. Plants showing poor growth should be dug with at least 3 to 4 inches of the root system. Loose soil can be gently knocked off the roots and the roots washed free of the remaining soil.

Healthy roots on a growing plant are whitish, fleshy and intact with regular branching. The subcrown internode between the seed and the crown should be white or cream after scratching off the papery covering. The crown and tiller bases, when split, should be cream to yellow on a mature plant. Any browning, blackening or redness on the roots, subcrown internode or stem base is an indication of a diseased plant.

Root and Crown Diseases
Sampling Procedure

SAMPLING TO DETERMINE DISEASE SEVERITY

One or two mildly infected plants in a field is of no concern, but higher numbers of infected plants or the numbers of plants becoming infected at a rapid rate is important.

Determining disease incidence or how severity is progressing requires repeatable and accurate sampling. Walk about 20 yards into a crop and then begin walking in a very large circle stopping at regular intervals so that 8 to 10 stops are made during the circuit.

Each time you stop, randomly choose a plant and inspect it for disease. Estimate the amount of disease on each plant and record the average.

Sampling Procedure, Neate, S. and McMullen, M., North Dakota State University, 2005
SHIPPING SAMPLES TO THE NDSU DIAGNOSTIC LABORATORY

• Collect samples from several plants.
• Collect large samples, e.g. whole leaves, whole plants.
• Place samples in a plastic bag loosely folded at the top, but not sealed.
• Wrap roots in damp (not wet) paper towels.
• Do not add moistened paper towels to plant leaves; there should be no surface moisture.
• Regular mail is sufficient if the sample is not sealed in plastic or sent late in the week.
• Complete a sample submission form found on www.ag.ndsu.nodak.edu/diaglab
  or,
• Include your name, address and phone number.
• Describe the problem (symptoms, when they began, spread, location in field, etc.)
• Provide background (field history, management, chemical use, neighboring fields, etc.)

Note: A fee may apply for disease diagnosis, see website for details.

Ship to:
NDSU Plant Diagnostic Lab
306 Walster Hall
Fargo, ND 58105-5012

Sampling Procedure
Net Blotch
(Pyrenophora teres)

SYMPTOMS
Small circular brown spots that develop into a chocolate brown net-like pattern on leaves, leaf sheaths and glumes. Some yellowing of the areas surrounding the net pattern. Severely affected leaves die.

HOSTS
Most current 6-rowed barley varieties are moderately susceptible to susceptible, 2-rowed barley is moderately resistant. Other crops are not affected.
**Net Blotch**

**CONTROL**
- Plant resistant varieties
- Apply fungicides
- Rotate with crops other than barley
- Destroy infected barley residue
Spot Blotch

(Bipolaris sorokiniana)

SYMPTOMS
On leaves, dark brown round or elongated spots that may join into larger irregular patches. Both spots and patches surrounded by yellow. Severely affected leaves die and dry up, leaving the characteristic brown lesion visible. If severe, brown spots can occur on glumes.

HOSTS
Recently released 6-rowed barley varieties have good resistance; most 2-rowed varieties are moderately susceptible. Wheat and durum are affected to a lesser extent.
CONTROL

• Plant resistant varieties
• Apply fungicides
• Avoid continuous barley; rotate with non-hosts, such as oats, rye, broadleaf species
• Destroy infected barley residue
• Use clean seed

Spot Blotch
Stagonospora Leaf Blotch

(*Stagonospora avenae f. sp. triticea*)

**SYMPTOMS**
Spots first appear as small yellow flecks, later becoming tan with a yellow border. Spots are boat-shaped at first, then merge to form blotches. The margins of the spots are indefinite. Leaves dry and shrivel.

**HOSTS**
All barley varieties are susceptible. Attacks wheat, durum and some grasses.
CONTROL

- Destroy infected cereal residue
- Apply fungicides

Stagonosporora Leaf Blotch
Speckled Leaf Blotch
(Septoria passerinii)

SYMPTOMS
Light brown elongated spots surrounded by yellow tissue with the margins of the leaf often dried. Spots may merge. Eventually, lines of very small black structures called pycnidia form in the brown tissue of the lesion.

HOSTS
Current barley varieties are susceptible. Other crops are not affected.
CONTROL

- Use most resistant varieties
- Apply fungicides
- Rotate with other crops
- Destroy infected barley residue

**Speckled Leaf Blotch**
Scald

(*Rhynchosporium secalis*)

**SYMPTOMS**
Leaf spots develop during cool, wet weather. The spots are oval shaped and bluish-green or water soaked and become bleached or straw colored with brown or tan margins.

**HOSTS**
All barley varieties are susceptible.
CONTROL

- Apply systemic fungicides
- Rotate with other crops
- Destroy infected barley residue
- Plant clean seed
Stem Rust
(Puccinia graminis)

SYMPTOMS
Dark red-brown spore masses on the stems and leaf sheaths. If severe, spores can form on the leaf blades, and glumes and awns.

HOSTS
Barley and wheat (Puccinia graminis f. sp. tritici), barley and rye (Puccinia graminis f. sp. secalis). Most current varieties are susceptible, but environmental conditions make epidemics rare.
CONTROL

- Apply fungicide sprays
Leaf Rust

(Puccinia hordei)

SYMPTOMS
Small orange-brown circular spore masses surrounded by a bleached or yellow halo develop on upper leaf surface. If severe, sheathes can be affected and leaves can die.

HOSTS
Barley, particularly late planted.
CONTROL

• Apply systemic fungicides

Leaf Rust
Powdery Mildew

(Blumeria graminis f. sp. hordei)

SYMPTOMS
White to buff or gray powdery masses of spores scattered on or completely covering the leaf blade. All above-ground parts of the plant can be affected. Symptoms are associated with yellowing, browning and death of leaf tissue.

HOSTS
Barley, particularly when cool, humid and overcast.
CONTROLL

- Apply fungicides

Powdery Mildew

Close-up of spore masses
Bacterial Blight

(Xanthomonas transluscens pv transluscens)

SYMPTOMS
Linear water-soaked areas and bacterial exudate droplets develop on leaves after several days of rainy, damp weather.

The lesions elongate and merge into irregular glossy-surfaced brown stripes.

HOSTS
Barley, wheat, durum and grasses.
Bacterial Blight

CONTROL

• Rotate with broadleaf species
• Destroy infected stubble
• Plant clean seed
SYMPTOMS
The virus is transmitted by several species of aphids, and symptoms can occur in patches. Bright yellow tips and margins of older leaves. Stunting, small seed and sterility.

HOSTS
Barley, wheat, oats, and other grasses.

Diseased plant (left)
CONTROL

- Plant resistant or tolerant cultivars
- Change timing of planting
- Increase plant nutrition and health
- Apply insecticides to control aphids

Barley Yellow Dwarf Virus

Aphid vectors of BYDV
Head Blight

*(Fusarium spp.)*

**SYMPTOMS**
Brownish lesions on the glumes or rachis. If severe, salmon-orange clusters of spores are seen as well as bleaching of heads and sterility.

**HOSTS**
Barley, wheat, durum, corn and many grasses.
CONTROL

• Rotate with broadleaf crops
• Apply fungicides
• Destroy infected residue
• Plant clean seed
• Plant more resistant varieties

Infected pink seed with black perithecia (fruiting bodies)
Loose Smut

(Ustilago nuda)

SYMPTOMS
Masses of olive-brown smut spores replace the entire head of plants with little development of floral bracts and awns. Smutted heads often emerge earlier than healthy heads. Spores are dislodged and scattered by wind when the delicate membranes surrounding them break. The fungus infects open flowers and becomes established in the embryo of the developing seed.

HOSTS
All barley varieties are susceptible to one or more races.
CONTROL

- Plant clean seed
- Apply fungicides

Cross-section of healthy (left) and infected seed (right)

Loose Smut
Covered Smut

(*Ustilago hordei*)

**SYMPTOMS**
Masses of dark brown smut spores replace the entire head of plants. Floral bracts and awns at least partially develop and spores are contained in a membrane until plant maturity when they are dislodged by threshing and infect the seed.

**HOSTS**
All barley varieties are susceptible to one or more races.
Covered Smut

**CONTROL**
- Plant clean seed
- Apply fungicides
Ergot

*(Claviceps purpurea)*

**SYMPTOMS**
Purple black ergots (sclerotia) with a pointed elongated grain shape replace one or more grains on the head. The sclerotia can be 2 to 4 times larger than the grain. During harvest the ergots can remain intact or break into pieces.

**HOSTS**
Barley, wheat, durum, rye, oats and grasses. Disease levels often are low, but cool, wet conditions at flowering can increase the disease.
**CONTROL**

- Plant clean seed
- Sclerotia in the field can be inactivated by burying 2 inches deep
- Rotate with non-host crops for at least two years

*Ergoted seed (left) and healthy seed (right)*

**Ergot**
**Black Point**

*(Alternaria spp., Bipolaris, Fusarium sp.)*

**SYMPTOMS**
Embryo ends of the grain become chocolate brown to black, and when more severe more of the grain darkens and becomes shriveled. Germination can be decreased.

**HOSTS**
All barley varieties are susceptible.
CONTROL

- Plant one of the few resistant cultivars
- Manage irrigation
Common Root Rot

*(Cochliobolus sativus)*

**SYMPTOMS**
Dark brown spots on the subcrown internode or on stems below the soil line. Crown rot develops later in the season. Affected plants may turn prematurely white. Kernels in the head are shriveled and roots are honey to dark brown and rotted.

**HOSTS**
Barley, wheat and durum. No variety is completely resistant; most are moderately susceptible to moderately resistant.

*Subcrown internode and seminal root infection*  
*Stem-base infection*
CONTROL

• Promote rapid emergence by planting in well prepared, warm seed bed
• Avoid herbicide stress
• Rotate with crops such as oats, or broadleaf crops
• Use fungicide seed treatment

Common root rot infection on subcrown internode: Healthy (left) through to severe (right)
Take-all

(Gaeumannomyces graminis var tritici)

SYMPTOMS
Characteristic root symptoms appear as early as four weeks and typically are seen as a black central cylinder within the root. Severely infected plants may show blackening of the crown and stem bases. As the plant matures, severe infection results in premature ripening, plant death and shriveled grain.

HOSTS
Wheat is susceptible, barley susceptible to moderately resistant, and rye and triticale moderately resistant. Oats will host a related organism, G. graminis var avenae. Most grass weeds host the disease; other crops do not.
CONTROL

- Rotate with a broadleaf crop
- Provide good plant nutrition
- Use fungicide seed treatment
- Biological control agents are in use outside of the U.S.

Blackened center of roots infected with take-all fungus
Pythium Root Rot

(Pythium sp.)

SYMPTOMS
Seedlings are stunted and slow growing, roots and stems become rotted and the seedlings die. Roots show a lack of root hairs and are stunted and brown. Crops show poor emergence and seedling growth.

HOSTS
A wide host range, including many agricultural crops. Generally associated with cool, wet conditions at seeding and during early growth.

CONTROL
• Avoid stubble retention and reduced tillage that may make the condition worse
• Improve phosphorus nutrition
• Use fungicide seed treatment
Nutrient Deficiency

SYMPTOMS
Stunted or uneven growth, yellowing, abnormal patterns of color on leaves and stems.
Poor yield. Barley cultivars can vary in their nutrient use efficiency.

CONTROL
• Apply appropriate nutrient in the current season
• Apply appropriate nutrient as a preventative measure before the next season
Physiological Leaf Spot

SYMPTOMS
Dark brown to light tan spots that vary widely in size and shape.

No pathogens are associated with the symptoms.
CONTROL

- None known
- Genetically inherited but only expressed under some environmental conditions

Physiological Leaf Spot
**Herbicide Damage**

**SYMPTOMS**
Decreased germination, abnormally developed roots, stunting, a range of head and leaf distortion, and changes to color. Barley cultivars vary in their sensitivity to various agricultural chemicals.

*Brown and chlorotic blotches on leaves*
Herbicide Damage

CONTROL

- Attention to appropriate rates of chemical application
- Attention to application technologies to reduce off-target effects

Healthy (far left) and stunted plants due to pre-emergent herbicide
Environmental Conditions

SYMPTOMS
Chlorotic bands on young leaves, sterility and chlorosis on head caused by frost. Yellowing and plant death caused by waterlogging.

CONTROL
• Time sowing to avoid frost damage on seedlings
• Avoid low areas prone to flooding

Chlorosis of heads and awns caused by frost