

Barley Disease Handbook

Stephen Neate and Marcia McMullen
Department of Plant Pathology, North Dakota State University



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.



Contents

Introduction.....	2
Parts of the Barley Plant.....	4
Parts of the Barley Spike.....	5
Leaf, Stem and Head Diseases.....	6
Root and Crown Diseases.....	7
Sampling Procedure.....	8

LEAF AND STEM

Net Blotch.....	10
Spot Blotch.....	12
Stagonospora Leaf Blotch.....	14
Speckled Leaf Blotch.....	16
Scald.....	18
Stem Rust.....	20
Leaf Rust.....	22
Powdery Mildew.....	24
Bacterial Blight.....	26
Barley Yellow Dwarf Virus.....	28

HEAD AND SEED

Head Blight.....	30
Loose Smut.....	32
Covered Smut.....	34
Ergot.....	36
Black Point.....	38

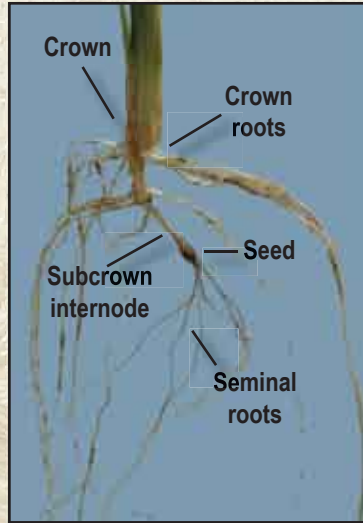
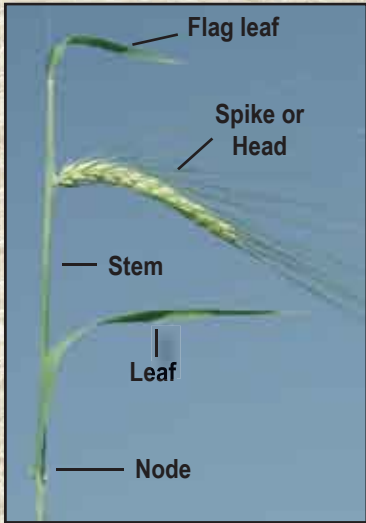
ROOT AND CROWN

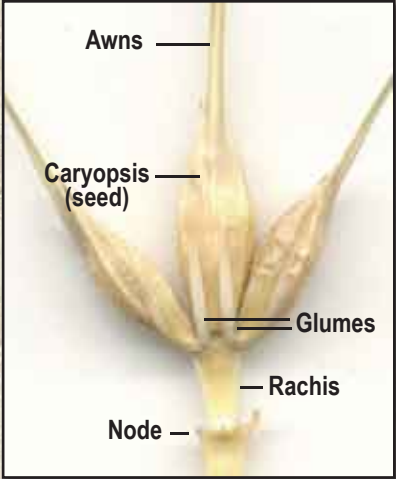
Common Root Rot.....	40
Take-all.....	42
Pythium Root Rot.....	44

ABIOTIC (non-biological)

Nutrient Deficiency.....	45
Physiological Leaf Spot.....	46
Herbicide Damage.....	48
Environmental Conditions.....	50

Parts of the Barley Plant





Parts of the Barley Spike

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

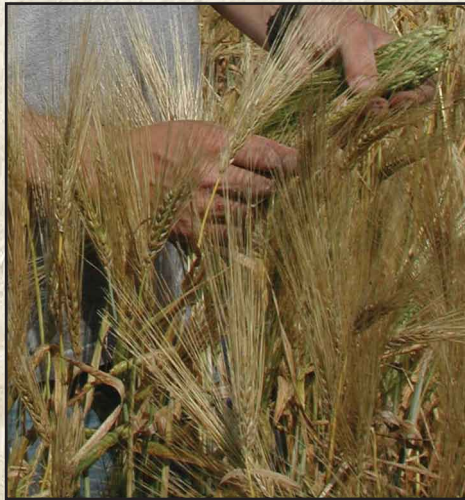
Sampling Procedure

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.



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.



CONTROL

- Plant resistant varieties
- Apply fungicides
- Rotate with crops other than barley
- Destroy infected barley residue



Net Blotch

**LEAF
AND
STEM**

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.

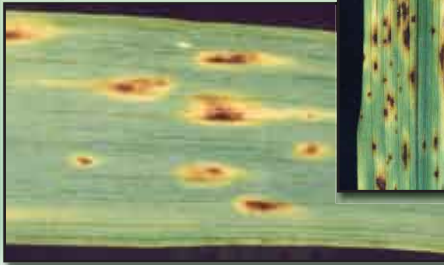


HOSTS

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



**LEAF
AND
STEM**

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



Stagonospora Leaf Blotch

LEAF
AND
STEM

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

LEAF
AND
STEM

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.

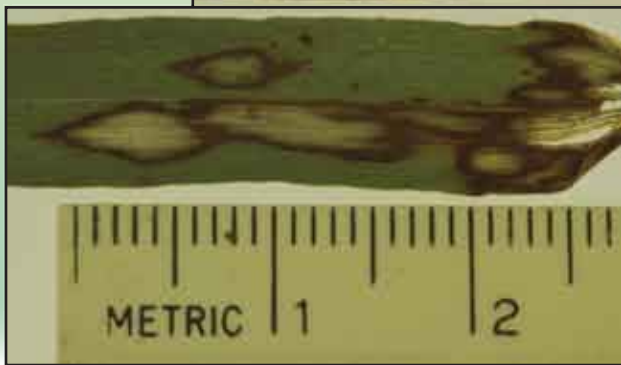
HOSTS

All barley varieties are susceptible.



CONTROL

- Apply systemic fungicides
- Rotate with other crops
- Destroy infected barley residue
- Plant clean seed



Scald

**LEAF
AND
STEM**

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



Stem Rust

**LEAF
AND
STEM**

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.

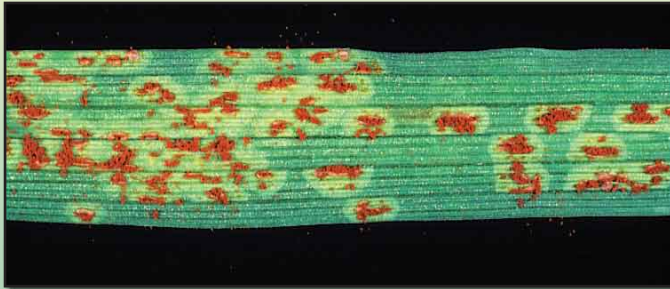
HOSTS

Barley, particularly late planted.



CONTROL

- Apply systemic fungicides



Leaf Rust

**LEAF
AND
STEM**

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.



CONTROL

- Apply fungicides



*Close-up of
spore masses*



Powdery Mildew

**LEAF
AND
STEM**

Bacterial Blight

(Xanthomonas translucens pv translucens)

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.



CONTROL

- Rotate with broadleaf species
- Destroy infected stubble
- Plant clean seed



Bacterial Blight

LEAF
AND
STEM

Barley Yellow Dwarf Virus

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



*Aphid vectors
of BYDV*

Barley Yellow Dwarf Virus

**LEAF
AND
STEM**

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)

Head Blight

**HEAD
AND
SEED**

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



**HEAD
AND
SEED**

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.



CONTROL

- Plant clean seed
- Apply fungicides



Covered Smut

**HEAD
AND
SEED**

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.



Ergot oozing honeydew



Germinating ergot fruiting structures

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

**HEAD
AND
SEED**

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



Black Point

**HEAD
AND
SEED**

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



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

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

**ROOT
AND
CROWN**

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

Take-all

**ROOT
AND
CROWN**

Pythium Root Rot

(Pythium sp.)

**ROOT
AND
CROWN**

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

Nutrient Deficiency

ABIOTIC

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

ABIOTIC

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





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

Herbicide Damage

ABIOTIC

Environmental Conditions

SYMPTOMS

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

Chlorosis of heads and awns caused by frost



CONTROL

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

Photographs supplied by:
Stephen Neate (NDSU)
Marcia McMullen (NDSU)
Paul Schwarz (NDSU)
Brian Steffenson (University of Minnesota)
NDSU, Department of Plant Pathology

Design and layout by Mary-Anne Fiebig (NDSU)
Financial support provided by North Dakota Barley Council

For more information on this topic see:

www.ag.ndsu.edu
Department of Plant Pathology
North Dakota State University
Fargo, ND 58105
Phone: (701) 231-8362

www.ndbarley.net
North Dakota Barley Council
505 40th St. S.W., Suite E
Fargo, ND 58103
Phone: (701) 239-7200

ISBN 0-9655645-1-7
May 2005



Root Rot



Spot Blotch



Net Blotch



Loose Smut



Head Blight

A joint production for North Dakota barley growers by:

North Dakota Barley Council
North Dakota State University

PP1293



NDSU is an equal opportunity institution.
This information is available in other
formats on request at (701) 231-7881